

4.0 CONCEPTUAL SITE MODEL

The conceptual site model for this SI was developed using results from this and previous investigations. It incorporates site geologic and hydrogeologic information, analytical results and comparison to screening values, a beneficial water use determination and a future land use assessment, an ecological risk assessment, a human health risk evaluation, and contaminant chemical and fate and transport characteristics.

4.1 PHYSICAL SYSTEM

4.1.1 Geology

The NPD laboratory site is located near the confluence of the Sandy and Columbia Rivers. The site is in the Columbia River floodplain and has been protected from 500-year floods by USACE levees. The area is described as Quaternary-age alluvium, including catastrophic flood deposits underlain by the Pleistocene Cascadian conglomerate, a volcanoclastic conglomerate derived from the uplifted Cascade Range (Tetra Tech 1999).

Soil in the area is classified as the Faloma silt loam (USDA 1983). This soil is poorly drained and is characteristic of the floodplains of the Columbia River. According to boring logs from the monitoring well installations (Tetra Tech 1998), subsurface soils predominantly consist of brown, coarse-grained, well-graded, well-rounded sand that becomes coarser with depth. Cobbles and silt are present occasionally.

Subsurface soil encountered during this investigation consisted primarily of gray or brown, silty, fine to coarse sand with occasional gravel. Layers of brown or gray silt were frequently encountered. The presence of mottling, iron staining, or organic material was common. Boring logs generated for this investigation are presented in Appendix A.

4.1.2 Hydrogeology

According to a study of the adjacent RMC site, located approximately ¼ mile north-northwest of the former NPD laboratory site, the project area is underlain by two aquifers (CH2M HILL 1996a). The upper aquifer is in unconsolidated sedimentary deposits and extends to a depth of 250 feet bgs. A deeper sand and gravel aquifer is hydraulically connected with the upper aquifer; the contact between the two aquifers is permeable.

The surface drainage at the site trends to the north toward the Columbia River. The site is at approximately 30 feet above sea level (USGS 1993) and generally has a flat topography.

A shallow unconfined aquifer is found at a depth ranging between 3 and 12 feet bgs and occasionally as high as 1 foot bgs in the peak wet season. Because of the site's proximity to the Sandy and Columbia Rivers, groundwater levels and flow directions are variable. Table 4-1 summarizes groundwater elevations and flow directions for water levels measured at the site between September 1997 and April 2003. The table shows that groundwater levels and flow directions vary throughout the year:

- Measurements collected in September indicate that groundwater was flowing toward the north-northwest toward the Columbia River with some localized variation. The water table is lowest during this part of the year.
- The measurement collected during February shows that groundwater was flowing generally toward the west, with the direction ranging from southwest to northwest. The groundwater elevation was approximately 10 feet higher than in September.
- Measurements collected during April and May indicate that the water table was nearly flat, and groundwater was slightly flowing toward the west, southwest, and south.

Based on the historical and recent groundwater flow directions, groundwater flows vary seasonally. Groundwater flow is toward the north in the dry season (e.g., September), and toward the west, southwest, and south in the wet season (February-May) when river flows are highest. Because of this fluctuating flow direction, each monitoring point is periodically located downgradient of one or more potential contaminant sources and is positioned to capture potential contamination that may emanate from these sources.

The monitoring well used for background (MW-1) is upgradient of the site building for part of the year, generally during the wet season. Occasionally, and specifically during September 2001, it was downgradient of the former dry well location. Monitoring wells MW-1, MW-2 and MW-3, and microwells MC-1 and MC-2 are located such that they are able to capture potential contamination originating from the building, the former fuel oil tank, the concrete sump, and the drainage ditch. Monitoring wells MW-4, MW-5, and MW-6 surround the landfill. At least one of the three wells is located downgradient of the landfill during most seasons of the year. Localized flow beneath the landfill in April 2003 indicates that all three of these wells were downgradient of the landfill at that time. The landfill monitoring wells are properly positioned for assessing groundwater conditions beneath the landfill.

The locations of the three temporary microwells installed west of the former laboratory were chosen based on historical information combined with a set of water level measurements collected at the start of the field investigation (September 5, 2001). The measurements collected

at the beginning of the investigation indicated that the groundwater flow direction was toward the north-northwest, and these three microwells were installed accordingly. The water level measurements collected 10 days later indicated that the flow direction near the former laboratory was toward the north, with localized flow beneath the south portion of the site toward the west, north, and east. This flow direction would indicate these microwells were located downgradient of the former laboratory. However, based on the variable historical and recent groundwater flow directions presented in Table 4-1, these microwells were located in an area that is downgradient of the former laboratory during most of the year. Therefore, these temporary microwells were placed appropriately for determining groundwater conditions west of the former laboratory.

The monitoring well and temporary microwell network was sufficient to assess groundwater quality beneath the entire site in this investigation. Monitoring wells and microwells were located such that, regardless of the flow direction, potential groundwater quality impacts sufficient to be of concern would have been detected by the groundwater sampling system. Based on the size of the site, the number of groundwater sampling points in the site investigation was adequate to capture any potential contamination that would be of concern.

4.2 BENEFICIAL WATER USE DETERMINATION AND LAND USE ASSESSMENT

4.2.1 Locality of Facility

The locality of the facility is an industrial setting with the following (see Figure 4-1):

- Reynolds Metals Company, a Superfund site, is immediately adjacent to the northern parcel. It is located between the project site and the Columbia River. As reported by the Reynolds Metals Company, the plant will be permanently closed and dismantled and the land will be sold and likely developed into smaller industrial properties.
- The City of Troutdale wastewater treatment plant abuts the eastern boundary of the northern parcel. It is located between the project site and the Sandy River.
- Northwest Graham Road is located immediately east and north of the southern parcel. Commercial buildings and a construction company are located on the eastern side of the street. Northwest Graham Road is a busy arterial with no sidewalks.
- The active Troutdale Airport is located immediately south of the southern parcel.

- Commercial buildings and pavement are located immediately west of the southern parcel.
- No residential developments or houses are located near the project site. The closest residential area is across Interstate 5, more than 1 mile from the former laboratory site.

4.2.2 Beneficial Water Use Determination

A beneficial water use determination (Appendix E) has been submitted to ODEQ by the USACE. Based on the preliminary beneficial water use determination (USACE 2002b), no surface water bodies directly receive discharges from the site. Groundwater beneath the site eventually discharges to the Sandy and Columbia Rivers after passing beneath the adjacent sites such as the RMC facility and the City of Troutdale wastewater treatment plant. Both rivers are designated high quality by the State of Oregon for potential public and domestic drinking water use. However, currently there are no surface water intakes within 5 miles of the site for drinking water on these rivers or other surface water bodies.

The USACE has placed a deed restriction on the use of site groundwater for future use as drinking water (Appendix E). Drinking water for the adjacent RMC facility is obtained from approximately 250 feet bgs from a well located approximately 1/2 mile from the site on the RMC property. Water used at the Troutdale Airport is obtained approximately 1/2 mile from the site, presumably from the same depth from which the RMC wells obtain water. Remaining drinking water in the vicinity of the site is groundwater via the City of Troutdale. The nearest well is located approximately 1 mile from the site. It is reasonably likely that groundwater in the locality of the facility will never be used as a drinking water source.

4.2.3 Land Use Assessment

A land use assessment has been submitted to ODEQ by the USACE and can be found in Appendix E. The future land owner of the site is expected to be Mount Hood Community College. The college plans to remodel the south third of the existing building into classrooms, use the center third as is for engineering material testing laboratories, and continue to use the north third for storage. The college currently has no plans to construct a building on the landfill portion of the site but probably will construct a parking lot to support activities in the southern portion of the site (USACE 2002a).

In February 2003, the USACE removed sediment from and decontaminated the concrete sump and removed the top 3 inches of topsoil inside and around the fence surrounding the former transformer pad. The USACE is scheduled to remove the landfill material in the summer of 2003. No additional remedial measures are currently planned.

4.3 LEVEL I ECOLOGICAL RISK ASSESSMENT

This section presents the findings and conclusions of a Level I (scoping) Ecological Risk Assessment (ERA) conducted for the project site. This ERA was conducted in accordance with ODEQ guidance (ODEQ 1998). ODEQ Level I ERA Attachments 1 and 2 are presented in Appendix F. A Level I ERA is a conservative qualitative determination of whether there is reason to believe that ecological receptors and/or exposure pathways are present or potentially present at or in the locality of the facility.

4.3.1 Existing Data Summary

Site Information

The southern parcel of the site is completely developed. A strip of landscaping grass and a drainage ditch along the eastern boundary of the site is the only portion of the southern parcel not paved or built upon. The northern parcel contains a landfill. The surface of the landfill was disturbed during field activities conducted for this SI. Current vegetation on the landfill material itself consists of sparsely distributed grasses and alfalfa, with numerous patches of bare ground. The margin of the northern parcel is roughly evenly split between cottonwood tree stands and Himalayan blackberry thickets. Areas of Scotch broom and grasses comprise the remainder of the dominant vegetation.

No permanent surface water exists at the site. The nearest permanent surface water is the Sandy River, which comes within approximately 0.1 mile of the southeast corner of the property and 0.3 mile of the northern boundary of the northern parcel. The drainage ditch that runs parallel to the eastern boundary of the site likely contains water only after heavy precipitation events, or possibly from groundwater during the peak wet season.

Hazardous Substance Releases

Several previous investigations (Section 1.1) have been performed at the site. Results of the current SI are presented in Section 2 and Appendix B.

The adjacent RMC facility was placed on the National Priorities List by the EPA in December 1994. Wastes from the facility, which is a primary aluminum reduction plant, included aluminum, mercury, fluoride, PAHs, PCB hydrocarbon mixtures, and cyanide (ATSDR 1997a). Wastewater from the RMC facility was originally disposed of into a wetland area between the plant and the Troutdale Airport. Wastes are currently treated onsite and ultimately discharged to the Columbia River. The RMC facility reportedly will be permanently closed and dismantled, and the land will be sold for industrial use (USACE 2002c). A deed restriction places a conservation area on the riverward side of the levee. Additional deed restrictions will be placed on the site in other areas, but the site eventually will be redeveloped.

The City of Troutdale sewage treatment plant, located immediately east of the former NPD laboratory site, discharges an average of 3 million gallons per day of treated wastewater into the Sandy River at River Mile 2.3. Releases of chemicals or other hazardous materials from the Troutdale Airport are unknown but may include petroleum hydrocarbons and deicing chemicals.

4.3.2 Sensitive Environments and Threatened or Endangered Species

The 6.43-acre site neither contains nor abuts any wetlands. The nearest known sensitive environments (according to OAR 340-122-115(49)) are a portion of the Mount Hood National Forest along the eastern bank of the Sandy River approximately 0.2 mile east (upstream) of the site, and the Columbia River Gorge National Scenic Area approximately 0.9 mile north (downstream) of the site.

The Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the National Heritage Foundation were contacted to establish the presence or absence of threatened or endangered species. At the time of publication of this document, official replies have not yet been received.

Chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*O. keta*) and steelhead (*O. mykiss*) are all listed as threatened under the Endangered Species Act. The Columbia and Sandy Rivers in the vicinity of the site are considered to be critical habitat for these three threatened salmonids. The Sandy River, from its confluence with the Columbia River upstream to Bull Run Dam, and the Columbia River are designated essential fish habitat for both chinook and coho salmon (*O. kisutch*) under the Magnuson-Stevens Act. The site does not contain any habitat suitable for any salmonid species and has no surface water connections with either the Sandy or Columbia Rivers.

4.3.3 Site Visit Summary

The site was visited during the late morning on July 23, 2002, by Burt Shephard and Cindy Jones of URS. The weather was sunny and warm, with few clouds and little wind. Photographs taken during the site visit are presented in Appendix G. Most of the site visit was spent in the northern parcel because ecologically important species that may be present would be seen in the woodlands and meadows abutting the site to the north and west.

Contaminants of Interest

All contaminants detected at the site during historical investigations and the current SI are considered contaminants of interest (COIs). These contaminants are listed in Appendix F, Attachment 1, Part 1.

Observed Impacts and Ecological Features

No direct observed impacts of chemical contaminants on potential ecological receptors were observed in either the northern or southern parcels of the site (Appendix F, Attachment 1, Part 2). Specific and extended efforts were made to observe staining or seeps from contaminants in the landfill; however, none were observed. Most of the landfill surface, which was visible, consisted of broken concrete chunks of various sizes and broken buckets or other containers. The landfill surface had been disturbed during field activities in September 2001, resulting in sparse ruderal vegetation in the areas where rooted plants could obtain a foothold. The base of the landfill material is several feet above the water table, thus reducing the likelihood that any contaminants in the landfill will come into contact with groundwater.

The southern parcel is either completely paved or contains buildings except for a strip of landscaped lawn with several plum trees. This landscaped strip runs the complete length of the eastern edge of the southern parcel. The drainage ditch, located in this strip, received contaminants that had been washed down the floor drains of the laboratory building. No obvious impacts of chemical contamination were observed in the drainage ditch. The paved and built up part of the southern parcel contains no ecologically important habitat.

Ecological features of the site are presented on Figure 4-2. A specific evaluation of ecological receptors and habitats is presented in Appendix F, Attachment 1, Part 3. Vegetation and wildlife species observed near the site are listed at the end of Appendix F.

Ecologically Important Species and Habitats

No ecologically important species were observed during the site visit on the site property, as discussed in Appendix F, Attachment 1, Part 4. However, portions of the RMC facility north and west of the northern parcel may contain ecologically important species and habitat. It contains a mixture of bottomland trees (mostly cottonwoods), thickets, and open meadows, which provide habitat for a variety of bird and mammal species. The drainage ditch along the eastern boundary of the site likely contains water too infrequently to provide ecologically important aquatic habitat and is not connected to any other surface water.

4.3.4 Ecological Exposure Pathways

The evaluation of the receptor-pathway interactions is presented in Appendix F, Attachment 2.

There is potential for wildlife species to come into contact with soil contaminants of the landfill in the northern parcel of the site. However, this potential is low due to the lack of vegetation or cover that would attract wildlife species. Wildlife occasionally traverse the landfill, as was confirmed through the observed scat of deer and a garter snake. Analytical data indicate that site contaminants are not observed in groundwater near the landfill. Therefore, groundwater does not

serve as an exposure pathway for site contaminants. Also, groundwater is not serving as a transport mechanism that moves soil contaminants offsite.

Removal of the landfill material from the northern parcel will eliminate future exposure of wildlife species to onsite soil contaminants. There will be no exposure pathway by which wildlife will be exposed to site contaminants. Complete exposure pathways currently do not exist in the southern parcel of the site.

4.3.5 ERA Recommendations

No ecologically important species or habitats are present in the southern parcel of the site. Historical remediation and removal activities performed at various locations in the southern parcel have reduced concentrations of metals, SVOCs, and PCB hydrocarbon mixtures in soil and groundwater of the southern parcel. The southern parcel of the site is not a significant source of contaminants to either soil or groundwater to which ecological receptors could be exposed, and therefore does not warrant further ecological evaluation in a Level II (screening) ERA.

No ecologically important species or habitats are present in the northern parcel of the site, although the areas to the north and west of the northern parcel contain ecologically important species and habitats. The landfill soil in the northern parcel is currently a potential source of metals, SVOCs, PCB hydrocarbon mixtures, and petroleum hydrocarbons to wildlife species that could ingest the soil. Based on groundwater analytical data (Section 2.3), the landfill waste material and soil is not impacting the groundwater surrounding the landfill. Therefore, wildlife species are not exposed to site contaminants via groundwater. Because the landfill material will be removed, it will not be a viable exposure pathway for wildlife in the future. Neither soil nor groundwater in the northern parcel will be a source of contaminant exposure to wildlife. The northern parcel does not warrant further ecological evaluation in a Level II (screening) ERA.

4.4 HUMAN HEALTH RISK EVALUATION

Past practices at the site have resulted in the presence of chemicals on the property at concentrations that may represent a human health concern. This section evaluates possible human exposures and chemicals detected at the site from a human health perspective. This evaluation will result in a recommendation of appropriate screening values for chemicals that might pose a health risk, based on the site land use and the chemicals detected at the site. These screening values can be used during this investigation and future remedial actions to evaluate whether existing or residual chemical concentrations are below levels that would warrant a human health risk.

The purpose of this evaluation is to identify the likeliest human exposures at the site, then identify chemicals that are a potential health concern using ODEQ risk assessment guidance (ODEQ 2000). Ultimately, screening values are identified for those chemicals for which the combination of site-specific exposures and concentrations exceeding risk-based screening levels indicate a potential health issue. This evaluation will determine whether calculation of site-specific screening levels is warranted or if use of default PRGs established by EPA Region 9 is reasonable (USEPA 2000a).

Sediment samples from the concrete sump and concrete samples collected from drums of hardened concrete in the landfill are not included in this risk evaluation. The sediment was removed and the sump decontaminated in February 2003, thereby eliminating any potential health risk associated with contaminants in the sediment. Likewise, drums of hardened concrete that were visible at the surface or uncovered during trenching were removed from the site by a licensed waste disposal contractor. Concentrations of chemicals of potential concern (COPCs) in sediment and concrete will be addressed later in this conceptual site model.

The visibly contaminated soil and debris excavated from trench TR-5 in the landfill were removed from the site by a licensed waste disposal contractor. Therefore, potential health risks associated with this known material has been eliminated from the site. Because similar material was not discovered elsewhere on the landfill surface or in the remaining four trenches, it is likely that the material at trench TR-5 was an isolated occurrence. However, conservatively, it is assumed that an unknown volume of this waste and contaminated soil potentially could exist elsewhere in the landfill. Therefore, the soil sample results from this trench are addressed in this human health risk evaluation.

4.4.1 Exposure Assessment

An exposure assessment identifies the populations potentially exposed to chemicals at the site and the means by which exposure could occur. The first step in the exposure assessment is an evaluation of the land use and demographics of the site in order to characterize the exposed populations. Then populations are identified that might encounter site chemicals. The next step specifies how exposure might occur.

Characterization of Exposed Population

Characterizing the exposed populations under both current and future conditions is required by EPA and ODEQ guidance (USEPA 1989; ODEQ 2000). Characterization first requires an understanding of where the site-related chemicals are present and where they may be present in the future. The populations that could encounter the chemicals can then be selected for evaluation in the risk assessment.

Land Use and Demographics. The following media have been identified as containing chemicals that exceed regulatory screening levels associated with the landfill and chemical practices at the former NPD laboratory site:

- Surface and subsurface soil
- Groundwater

Soil contamination exceeding the regulatory screening levels is found in the landfill, the drainage ditch outside the laboratory, and the former fuel oil storage tank excavation. Shallow groundwater near the drainage ditch appears to have been impacted by site-related chemicals. The aquifer beneath the site is at an average depth of approximately 7 feet, ranging roughly from 3 to 12 feet bgs. Chemicals in groundwater are not thought to have reached the nearest surface water bodies, the Columbia River and Sandy River.

The current and future land use for this area is classified as commercial/industrial (USACE 2002a). Currently the main building is unoccupied but used for storage. The current land use plans include building a parking lot at the location of the landfill and using the laboratory building for community college education and storage. Therefore, site use likely will include only adults. The people spending the most time at the site over the long term would likely be employees of the college, with students having generally a much shorter duration visit.

The nearest residential population to the site is the City of Troutdale, located approximately 1 mile to the south on the south side of Interstate 84.

Selected Populations. Populations identified in risk assessments include those who receive the most exposure to site chemicals or are more sensitive to the toxic effects of chemicals. The most-exposed or most-sensitive groups differ depending on whether carcinogenic or noncarcinogenic effects of chemicals are considered. Carcinogenic risks are usually greatest for the population that spends the longest time at the site and receives the longest exposure to site chemicals (i.e., largest dose over a lifetime). Noncarcinogenic effects, on the other hand, are assessed based on the daily intake or dose per body weight along with short-term sensitivity to toxic effects. The following populations were selected for further discussion:

- Current and future adult construction workers
- Current and future adult workers at the community college
- Adult students attending classes at this location

The population of concern for exposure to surface and subsurface soils are construction workers. Construction workers are also a population of concern for exposure to groundwater because groundwater can be as shallow as 1 to 3 feet bgs during the peak wet season and exposure may occur during intrusive activities. It should be noted that the term “construction worker” as

defined by USEPA (2001) is a short-term receptor who is exposed to subsurface contaminants during the work day for the duration of a construction project (typically a year). This worker population includes both utility and other types of excavation workers because the scenario (as defined by USEPA 2001) involves substantial onsite exposures to surface and subsurface soils under high exposure assumptions (i.e., soil ingestion rate, soil adherence factor).

Site workers and students could be exposed to materials in surface soil and, potentially, groundwater beneath the building. Teachers and students could be indirectly exposed to chemicals in groundwater through inhalation of volatile chemicals in the groundwater volatilizing and migrating through the soil and into the building.

Because of the distance to the nearest residential neighborhood, the location of the neighborhood across an interstate highway, and the lack of attractive nuisances on the property (e.g., small streams, exposed landfill materials), a child trespass scenario is considered unlikely. Risk assessments evaluate long-term risks over many years and regular child trespass would be unlikely to occur on the property.

Identification of Exposure Pathways

Several possible pathways of exposure may exist at the site. An exposure pathway is the mechanism by which a receptor (human) is exposed to chemicals from a source. The following four elements constitute a complete exposure pathway:

- A source and mechanism of chemical release
- A retention or transport medium (e.g., soil)
- A point of potential human contact with the affected medium
- A means of entry into the body (e.g., ingestion) at the contact point

Only complete pathways containing all four elements result in exposures. The conceptual site model (Figure 4-3) describes the complete pathways for this site. In addition, the current and future exposure pathways considered for the characterization of the site are discussed in more detail below. The following potential pathways at the site will be examined for completeness:

- Incidental ingestion of and dermal contact with chemicals in surface and subsurface soil and groundwater
- Inhalation of vapors and dusts generated from disturbed surface soil and inhalation of vapors from undisturbed subsurface soil
- Inhalation of vapors from groundwater during construction activities

- Ingestion of groundwater as drinking water
- Inhalation of indoor air vapors from groundwater due to vapor intrusion inside site building

The rationale for selecting pathways for quantitative evaluation and eliminating pathways considered incomplete or relatively insignificant sources of risks are discussed in the following subsections.

Contact with Soil and Groundwater by Construction Workers. Construction workers would disturb soil if they, for example, constructed a road or installed underground utilities through the area. Therefore, current and future construction workers could be exposed to chemicals in surface and subsurface soil by ingestion, dermal contact, and inhalation while performing work that involves soil disturbance.

Because there is shallow groundwater at this site, current and future construction workers could be exposed to chemicals in groundwater by dermal contact and inhalation while performing work that involves soil disturbance. Inhalation of chemicals in groundwater would occur only for volatile compounds.

Contact with Surface Soil by Employees and Students. Occupants of the existing building (i.e., future teachers and students of the community college) could potentially be exposed to site soil through incidental ingestion, dermal contact, and inhalation of vapors and fugitive dust. While this exposure pathway is limited, it is considered complete.

Groundwater as Drinking Water. Currently, the site groundwater is not used as drinking water, which is obtained from municipal sources. In addition, the USACE has placed a deed restriction on the use of site groundwater as a future drinking water source (USACE 2002b). Therefore, groundwater as a drinking water source is not considered a complete pathway at this site.

Indoor Air. The site's building is currently unoccupied, but there are currently plans to use it as a portion of a community college campus. Therefore, exposures to vapors from groundwater under the building that could potentially intrude inside the building are a potential concern. Employees and students could be exposed to chemicals in indoor air through the inhalation pathway. This pathway is considered potentially complete for volatile chemicals because it meets all four elements that constitute a complete pathway. For chemicals that do not meet EPA's definition of a volatile, this pathway is incomplete.

Surface Water Exposures for Recreational and Residential Populations. The limited amount of impacted groundwater and the distance to the Columbia and Sandy Rivers indicate that impacts to surface water are very unlikely. Therefore, this pathway is considered incomplete. If chemicals were to reach the rivers, exposures to humans would be possible through drinking the water, water exposures during recreational activities, and (indirectly) through ingestion of impacted fish.

4.4.2 Selection of Chemicals of Potential Concern

The exposure assessment (Section 4.4.1) identified several exposure pathways as potentially complete at this site. The next step in the evaluation process is to assess whether any chemicals are present that might pose a health risk. Typically, not all chemicals present at a site pose health risks or contribute significantly to overall site risks. EPA and ODEQ guidelines (USEPA 1989; ODEQ 2000) recommend focusing on a group of COPCs based on inherent toxicity, site concentration, and behavior of the chemicals in the environment.

The relevant sampling investigations are summarized below, followed by the selection of COPCs.

Sampling Investigations

In 2001, investigative activities took place to assess whether contaminated soil remains at locations where soil removal activities were previously conducted, and to document that past laboratory activities, including the use of the landfill, have not adversely impacted soil or groundwater quality beneath the site. During the 2001 sampling activities, data were collected from groundwater, soil, sump sediment, and concrete. In addition, data were collected from buckets containing soil from the Umatilla Army Depot Borrow Site that were stored at the former NPD laboratory. In 2003, additional groundwater sampling activities occurred. Details of these sampling activities and results are discussed in Section 2. The discussions in the following paragraphs summarize which of the data from the 2001 and 2003 sampling investigations were considered appropriate for use in the human health screening evaluation.

All of the soil data collected from the site were used in the human health evaluation. A total of 51 soil samples were collected from 33 locations across the site (SS-001 through SS-033). The samples were analyzed as presented in Table 2-2. Five soil samples collected from three of the sampling locations (SS-001, SS-002 and SS-032) were considered representative of background concentrations (where past site activities were not likely to have impacted soil) and were used for comparisons of site concentrations relative to background concentrations. The remaining 46 samples were used in the screening process for the selection of COPCs.

All of the groundwater data collected from the site were used in the human health evaluation. One sample was collected from each of 11 wells across the site: 5 temporary microwells (MC-1 through MC-5) and 6 existing monitoring wells (MW-1 through MW-6) in 2001. The six monitoring wells were sampled again in 2003. The samples were analyzed for VOCs, SVOCs, pesticides, PCB hydrocarbon mixtures, total and dissolved metals, and total cyanide (Table 2-2). One well, MW-1, is located at the southern end of the site, usually upgradient of the contamination sources, and is considered representative of background concentrations. Data from this well were used for comparison of site groundwater concentrations relative to background concentrations. Data from the remaining 10 wells were used in the screening process for the selection of COPCs.

The data collected from the buckets containing soil from the Umatilla Army Depot Borrow Site that were stored at this site were not used in the screening assessment because these data are not representative of soil conditions at the former NPD laboratory site. The sediment sample (SD-001) collected from the concrete sump and the concrete sample (DC-001) collected from representative drums containing solidified concrete were not used in the screening assessment because no human health exposure pathways to these materials are complete.

Table 4-2 lists the soil and groundwater samples used in this evaluation. Soil and groundwater sampling locations of data evaluated in this assessment are shown in Figure 2-1.

Data Quality and Usability. Optimizing data usability reduces uncertainty in environmental data used in a human health evaluation. *Final Guidance for Data Usability in Risk Assessment* (USEPA 1992) provides practical guidance on how to obtain an appropriate level of quality of all environmental analytical data required for human health risk assessments.

Data Usability. The four data application questions requiring an answer from the EPA 1992 guidance are as follows:

- *What contamination is present, and at what levels?* The types of contamination include concentrations of metals, PCB hydrocarbon mixtures, and solvents. The source of contamination is from a variety of laboratory waste that was directly disposed of in the dry well and the landfill, as well as untreated discharges from the laboratory into the drainage ditch.
- *Are site concentrations different from background?* Concentrations of chemicals that occur on site in the absence of site activities are defined as background concentrations. Comparison of site data to background concentrations allows determination of the degree of contamination. Background concentrations were used only for metals in soil and groundwater; background was assumed to be zero

for the organic constituents. Metals concentrations in soil used for screening were compared with the available background values for metals in soil for the Clark County, Washington, region (Ecology 1994); the RMC facility background values (CH2M HILL 1996b); and the range of site background soil concentrations. Except for beryllium, maximum metals concentrations exceeded the site background concentrations and RMC background concentrations (Section 4.4.3). Aluminum, iron, and manganese maximum detected concentrations were below soil background concentrations for the region; however, these chemicals were included in the COPC screening because of their exceedances above local background.

For groundwater, metals concentrations used for screening were compared with the upgradient well groundwater concentrations and the shallow groundwater background values for the RMC facility. Only barium, iron, magnesium, and manganese maximum detected concentrations were below the groundwater background concentrations for the site. All other metals in groundwater were then screened against their respective screening toxicity values.

- *Are all exposure pathways and areas identified and examined?* Sufficient site knowledge exists to understand potential current and future exposure pathways. Exposure pathways are identified and discussed in Section 4.4.1. In addition, exposure pathways are illustrated on the conceptual site model in Figure 4-3.
- *Are all exposure areas fully characterized?* Sufficient data exist to identify the COPCs at the site that require cleanup levels. Sample design was not done for risk assessment purposes; however, because risks are not calculated, the data are of acceptable quality to conservatively select chemicals that might pose a human health risk and, thus, require screening values.

Detection and Reporting Limits. Sometimes reporting limits do not meet risk assessment requirements (i.e., limits are above the screening toxicity value of the chemical). If a chemical was not detected in a sample, it could be present at a concentration just below the reporting limit, or it may not be present in the sample at all. If the reporting limit is below the screening toxicity value, the resulting data set provides the risk assessor with a higher degree of certainty in identifying COPCs. Reporting limits exceeding sample toxicity values may be a particular concern for chemicals that are not selected as COPCs because those chemicals could potentially be present at levels that warrant a health concern. If the chemical was never detected, it was assumed not to be present. However, if the chemical was detected at least once in any sample, then the reporting limits were further evaluated, as per ODEQ (2000) guidance.

The adequacy of reporting limits for the detected chemicals was evaluated by comparing the reporting limit for each detected chemical in each environmental medium to its screening toxicity values. If the reporting limit was less than the screening toxicity value, it was considered adequate. If the reporting limit was greater than the screening toxicity value, concentrations could be either overestimated or underestimated. The *Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A)* (USEPA 1989) describes the sample quantitation limit as the laboratory quantitation limit (also referred to as the method reporting limit [MRL]) adjusted to reflect sample-specific factors such as dilution, use of a smaller sample aliquot for analysis, or matrix interference. The method detection limit (MDL) is defined as the minimum concentration of an analyte that can be routinely identified using a specific method. The practical quantitation limit (PQL) is the “expected” concentration that can be reliably achieved by a specific method (Corl 2002). The MRL is the minimum level at which an analyte can be accurately and reproducibly quantitated in a sample. MRLs can be as low as the MDL or exceed the PQL, depending on matrix effects encountered during the analysis. MRLs are typically used in risk assessment data evaluation because they “take into account sample characteristics, sample preparation, and analytical adjustments” (USEPA 1989) and are considered to be the most relevant quantitation limits for evaluating nondetected chemicals. However, MRLs are not available for every sample in this evaluation. For the 2001 and 2002 sampling investigations, the laboratory reported only the PQL and the MDL for each sample. In this assessment, the lowest level reported by the lab was compared to the screening levels. Thus, for the 2001 and 2002 samples, the MDL was compared to the screening levels; and for the 2003 samples, the MRL was used.

Only two detected chemicals in groundwater, carbon tetrachloride and arsenic, were identified as having MDLs and MRLs greater than the screening value. Carbon tetrachloride’s reporting limit exceeded its screening value of 0.17 µg/L in 8 out of 14 nondetected results. Arsenic’s reporting limit exceeded its screening value of 0.045 µg/L in all 12 of the nondetected results. The reporting limits for all other detected chemicals in groundwater and soil were adequate for risk assessment purposes. Both carbon tetrachloride and arsenic were ultimately selected as COPCs in groundwater (see Section 4.4.3). Therefore, the inadequacy of the reporting limits for these chemicals is not likely to affect this assessment. The presence of these chemicals in groundwater is further evaluated in subsequent sections.

4.4.3 Chemical Selection Process

A screening of the COIs was performed using the ODEQ (2000) recommended three-step screening process to select COPCs. COIs were screened on the basis of frequency of detection, exceedance over background concentrations, and exceedance over risk-based screening levels, as described below, to determine whether they qualify as COPCs. Chemicals ultimately selected as COPCs will be further evaluated to determine what the appropriate screening value should be, if any, for each COPC in each medium.

Frequency of Detection

All detected chemicals in soil and groundwater were evaluated for their frequency of detection. In accordance with ODEQ guidelines, chemicals detected in less than 5 percent of the samples for each medium were assumed to be isolated occurrences and not representative of the site or the data set, provided that the chemicals' reporting limits are adequate. Therefore, these chemicals were not considered COIs and were not carried forward in the screening to select COPCs. Likewise, chemicals detected in greater than 5 percent of the samples were labeled COIs and were carried forward in the screening process. The results of the frequency of detection screening for soil and groundwater are summarized below and on Tables 4-3 and 4-4, respectively.

A total of 46 soil samples were collected from across the site, and a total of 85 chemicals were detected at least once in any of these soil samples. An evaluation of the reporting limits revealed that all of the detected chemicals in soil have adequate reporting limits (Section 4.4.2). Of these 85, the 24 chemicals listed below were detected in less than 5 percent of the samples and were not retained as COIs:

- 1,1,2,2-Tetrachloroethane
- 1,2-Dibromoethane
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 4-Methyl-2-pentanone
- Bromomethane
- Carbon tetrachloride
- Chlorobenzene
- Chloromethane
- Naphthalene
- Styrene
- 3- & 4-Methylphenol
- 4,4'-DDD
- 4,4'-DDE
- bis(2-Ethylhexyl)phthalate
- Dibenzo(a,h)anthracene
- Diethylphthalate
- Pentachlorophenol
- Cyanide
- Isopropylbenzene
- Methylene chloride
- Toluene
- Trichloroethene

In addition to their infrequent detection, the above chemicals are also unlikely to present a health risk because their maximum detected concentration did not exceed a risk-based screening level, with the exception of 1,2-dibromoethane (Table 2-14). The compound 1,2-dibromoethane was detected in 1 soil sample out of 42, and the single detection was approximately two times the risk-based screening level. This chemical does not require a screening value because (1) the exceedance is low magnitude, (2) the material sampled has been removed from the site (trench TR-5), and (3) future land use assumes the landfill will be removed and the surface paved (planned parking lot).

The remaining Table 4-3 chemicals were detected in more than 5 percent of the samples and were labeled as COIs to be carried through for chemical screening.

A total of 30 chemicals were detected in groundwater and evaluated for their frequency of detection. Only total metals are included in this evaluation, per the guidance. As only 15 groundwater samples were collected from the site (excluding the background samples and field duplicates), all 30 of the detected chemicals were detected in greater than 5 percent of the samples. Therefore, all detected chemicals in groundwater were labeled as COIs (Table 4-4).

Background Concentration Screen

Concentrations of chemicals that occur onsite in the absence of site activities are defined as background concentrations. Comparison of site data to background concentrations allows for determination of the degree of contamination. Background concentrations were used only for metals in soil and groundwater; for the organic analytes, background was assumed to be zero, as per ODEQ (2000) guidance.

Maximum detected metals concentrations in soil were compared with the available background values for metals in soil for the area. The regional background values for Clark County, Washington (Ecology 1994) were used for qualitative comparison because Clark County is located approximately 15 miles east of Troutdale, Oregon, along and across the Columbia River. Chemicals were not excluded from the screening for COPCs on the basis of these regional background concentrations.

The background concentrations available for the adjacent RMC site are likely more representative of background concentrations at the former NPD laboratory site. The RMC facility is located approximately 1/4 mile north-northwest of the NPD laboratory site. The *Background Summary for RMC-Troutdale* (CH2M HILL 1996b) investigated background concentrations for a number of media for the RMC facility in Troutdale, Oregon, including soil, groundwater, sediment, surface water, and fish tissue. The range of background metals concentrations for upland surface soil at the RMC site were evaluated in the background screening for this evaluation.

The third set of background values used in this evaluation were five soil samples collected at the NPD laboratory site that were designated as representative of site background concentrations. The range of background metals concentrations collected from the site were also evaluated in the background screening process. Aluminum, beryllium, iron, and manganese were the only metals with maximum detected concentrations below background concentrations for the entire region (Clark County). Of the detected concentrations for beryllium, only the maximum was below background concentrations for both the site and the adjacent RMC site. Therefore, the presence of beryllium in soil is likely not site-related but, rather, representative of background. This

chemical was not selected as a COI and was not carried forward in the screening for COPCs. All other metals were selected as likely above local background and were carried forward as COIs (Table 4-5).

For groundwater, maximum detected total metals concentrations were compared with available background groundwater data from two sources: (1) analytical results from MW-1, located upgradient of the contamination source, and (2) shallow groundwater background data for the RMC facility (CH2M HILL 1996b). Maximum detected concentrations for barium, iron, magnesium, and manganese were below the background concentrations for the site. Therefore, these chemicals were not labeled as COIs and were not carried forward in the screening for COPCs. All other metals in groundwater were considered COIs (Table 4-5) and screened against their respective risk-based screening concentrations in the COPC screening assessment.

Concentration-Risk Screen

Chemicals identified as COIs in the frequency screening assessment and the background screening assessment were further evaluated in the concentration-risk screen for the selection of COPCs. The concentration-risk screen consists of comparing the maximum detected concentration of COIs in each medium with risk-based screening levels. As per ODEQ (2000) guidance, COPC screening must take into consideration the potential for risk to be posed by exposure to (a) individual COPCs in an individual medium, (b) multiple COPCs within a given medium (i.e., cumulative risk), and (c) individual or multiple COPCs within different media. Chemicals whose maximum detected concentrations exceeded the risk-based screening levels were selected as COPCs. The risk-based screening levels selected for this screening assessment are discussed below for soil and groundwater.

To identify COPCs in soil, maximum detected chemical concentrations in soil were screened against EPA Region 9 industrial soil PRGs (USEPA 2000a). EPA Region 9 PRGs are risk-based tools for evaluating and cleaning up contaminated sites. The EPA Region 9 PRG table combines current EPA toxicity values with “standard” exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered protective of humans, including sensitive groups, over a lifetime. EPA Region 9 soil PRGs are protective of the ingestion, dermal contact, and inhalation exposure pathways and are chemical concentrations in environmental media that correspond to acceptable levels of risk (1 in 1 million excess carcinogenic risk or a hazard quotient of one for noncarcinogens). EPA Region 9 has developed soil PRGs for both the residential and industrial scenarios. The industrial soil PRGs, rather than the residential PRGs, were used as the risk-based screening levels because, based on current and future land use at this site, adults are the only population of concern and residential soil exposures are not expected at this site (Section 4.4.1). Therefore, the industrial soil PRGs are considered sufficiently protective in this screening assessment.

To identify COPCs in groundwater, maximum detected chemical concentrations were compared to EPA Region 9 tap water PRGs (USEPA 2000a), EPA MCLs (USEPA 2000b), and EPA AWQC (USEPA 1999a). The tap water PRGs are protective of drinking the water every day for a lifetime and inhaling vapors generated by volatile compounds during normal domestic water use (e.g., cleaning and showering). Site groundwater is not currently being used as a drinking water source, and a deed restriction will prevent site groundwater from being used as a drinking water source in the future (USACE 2002b). Therefore, the only pathway of exposure to chemicals in groundwater is through inhalation of vapors emanating through the soil and into the building. Thus, the tap water PRGs are considered sufficiently protective of site exposures to groundwater.

EPA MCLs apply to any water with the potential to be used as a drinking water source. The MCL is defined as the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCL goals as feasible using the best available treatment technology and taking cost into consideration (USEPA 2000b). MCLs are the legal limits for chemicals in drinking water. MCLs are usually developed initially using risk assessment techniques based on human health. However, in the rule-making process, other considerations such as cost, protectiveness, and what is achievable by current technology can also affect the final MCL value. In some cases, tap water PRG concentrations for a chemical are lower (more health protective) than the chemical's MCL (e.g., vinyl chloride); in other cases the reverse is true (e.g., trichloroethene).

Because site groundwater discharges to the Sandy and Columbia Rivers, maximum detected concentrations in groundwater were also compared to EPA AWQC values. AWQCs are based solely on data and scientific judgments on the relationship between pollutant concentrations and environmental and human health effects. Unlike the MCLs, AWQCs do not reflect consideration of economic impacts or the technological feasibility of meeting the chemical concentrations in ambient water (USEPA 1999a). AWQCs protective of human health are derived for both the fish ingestion pathway alone and for water ingestion plus the fish ingestion pathways. Because the Sandy and Columbia Rivers are both high-quality streams designated by the state of Oregon for potential use for public and domestic drinking water, the AWQCs derived for the water ingestion plus fish ingestion pathway were used in this screening evaluation.

The discussions below summarize the three-step screening process outlined above. Tables 4-6 and 4-7 summarize the concentration-risk screen process for soil and groundwater, respectively.

Individual COPCs within a Given Medium. Individual COIs in soil and groundwater were compared to the screening levels identified above for each medium to assess the potential risk associated with the individual COPCs in a given medium. The risk ratio for each COI in each medium was calculated using the methodology presented in the ODEQ guidance (ODEQ 2000):

$$R_{ij} = C_{ij} / SL_{ij}$$

where:

R_{ij} = risk ratio for COI, i, in medium, j

C_{ij} = maximum detected concentration of COI, i, in medium, j

SL_{ij} = screening level for COI, i, in medium, j

Any COI whose risk ratio was greater than 1 was selected as a COPC. As shown on Table 4-6, the only chemicals selected as individual COPCs in soil are benzo(a)pyrene and arsenic. The maximum benzo(a)pyrene concentration was six times greater than the screening level and 12 percent of the benzo(a)pyrene samples exceeded the screening level of 2.9 mg/kg. Fifteen percent of the samples analyzed for arsenic exceeded the screening level of 2.7 mg/kg. The maximum detected arsenic concentration only slightly exceeded the screening level by a factor of 4.

As shown on Table 4-7, the only chemicals selected as individual COPCs in groundwater were carbon tetrachloride and arsenic. Carbon tetrachloride was detected in only 1 out of 15 samples (7 percent). The detected concentration of 0.281 µg/L only slightly exceeded the tap water PRG of 0.17 µg/L and the AWQC of 0.25 µg/L. However, the detected carbon tetrachloride concentration was much lower than the MCL of 5 µg/L. Arsenic was detected in 3 out of 15 samples (20 percent). All three detections of arsenic in groundwater exceeded both the tap water PRG and the AWQC. The maximum detected concentration of 1.86 µg/L was 41 times greater than the tap water PRG of 0.045 µg/L and 100 times greater than the AWQC of 0.018 µg/L. However, no detection of arsenic exceeded the MCL of 10 µg/L. Because the maximum detected concentrations of these chemicals exceeded one or more of the groundwater screening levels, carbon tetrachloride and arsenic were identified as COPCs.

Multiple COPCs within a Given Medium. Multiple COIs in soil and groundwater were collectively compared to the screening levels identified above to assess the potential risk associated with cumulative (additive) effects of multiple COIs. Multiple COIs in soil and groundwater were selected as COPCs using the ODEQ (2000) methodology. Risk ratios for multiple COPCs in a given medium were calculated as follows:

$$R_{ij} / R_j$$

where:

R_{ij} = risk ratio for COI, i, in medium, j

$$R_j = \sum_{i=1}^I R_{ij}$$

Any COI whose risk ratio calculated as described above was greater than $1/N_{ij}$ (where N_{ij} is the total number of i contaminants in medium j) was selected as a COPC based on cumulative effects. As shown on Table 4-6, the chemicals selected as COPCs based on their additivity within soil are Aroclor® 1254, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, arsenic, and iron. As shown on Table 4-7, the chemicals selected as COPCs based on their additivity within groundwater are arsenic and antimony.

Individual COPCs within Multiple Media. Individual COIs within soil and groundwater were evaluated to assess the potential risk associated with the additive effects of multimedia exposures for a given COI. No chemicals were selected as COPCs based on multimedia exposures. As previously discussed in the exposure assessment, the only populations likely to be exposed to chemicals in both media are future construction workers inhaling groundwater vapors while conducting subsurface soil disturbing activities. Thus, the only chemicals that a construction worker would be exposed to in these two media simultaneously would be volatile chemicals. Therefore, only VOCs in soil and groundwater were evaluated for additive effects across media. Only two volatile COIs were detected in both soil and groundwater: TCA and phenanthrene. Phenanthrene does not have screening criteria and was not selected as a COPC on the basis of multimedia exposures. TCA was not selected as a COPC because the concentrations in the separate media were not found to be a concern from additive exposures.

COIs without Screening Criteria. Several of the chemicals detected in soil and groundwater do not have available screening criteria. Therefore, as per ODEQ (2000) guidance, these chemicals are identified as COPCs. Further discussions regarding whether these chemicals are likely to present a health risk at the site are included in Section 4.4.4. The following chemicals were selected as COPCs on the basis of no screening criteria:

For soil:

- 2-Hexanone
- Phenanthrene
- Benzo(g,h,i)perylene
- Calcium
- Magnesium

For groundwater:

- Phenanthrene
- Calcium
- Potassium
- Sodium
- Diesel-range petroleum hydrocarbons
- Motor-oil-range petroleum hydrocarbons

Summary of COPCs. Table 4-8 summarizes the screening results for soil and groundwater. Fifteen chemicals in soil and eight chemicals in groundwater were selected as COPCs in accordance with the ODEQ screening procedures. The majority of these chemicals were selected by default because no screening criteria are established for them. All COPCs are further evaluated in the next two sections to determine which require screening values and which screening values are most appropriate based on site land use.

4.4.4 Chemicals Without Available Screening Criteria

Nine chemicals were selected as COPCs (in the previous section) in soil and groundwater by default because they do not have available screening criteria:

- 2-Hexanone
- Benzo(g,h,i)perylene
- Calcium
- Magnesium
- Phenanthrene
- Potassium
- Sodium
- Diesel-range petroleum hydrocarbons
- Motor-oil-range petroleum hydrocarbons

Because of the lack of toxicity criteria, there is uncertainty whether these chemicals pose a health risk at the site. Based on the types of chemicals without criteria and their site concentrations, the presence of these chemicals at the site is not likely to be a health concern. Thus they do not require the development of screening values for the following reasons:

- Of these nine chemicals, calcium, magnesium, potassium, and sodium are considered essential nutrients and under normal circumstances are not associated with toxicity to humans.
- Because of the chemical structure and physical properties of phenanthrene, its toxicity is likely similar to that of naphthalene. The maximum detected concentration of phenanthrene in soil of 2.8 mg/kg is significantly less than screening value for naphthalene of 190 mg/kg. The maximum detected concentration of phenanthrene in groundwater of 0.0629 µg/L is also significantly less than the tap water PRG for naphthalene of 6.2 µg/L. Thus, it is unlikely that phenanthrene is present in concentrations that would warrant a health concern.
- Of all the PAHs, the toxicity of benzo(g,h,i)perylene is likely most similar to that of pyrene, the least toxic PAH (with the exception of anthracene). The maximum detected concentration of benzo(g,h,i)perylene of 0.398 mg/kg is significantly below the screening value for pyrene of 54,000 mg/kg. Therefore, the lack of a risk-based screening level for benzo(g,h,i)perylene is not likely a health concern.
- Five soil samples at the site were analyzed for diesel-range and motor-oil-range petroleum hydrocarbons. While ODEQ does not currently recommend the use of any screening criteria for these compounds, Ecology has derived a method to evaluate the toxicity of these compounds using the surrogate approach developed by the Total Petroleum Hydrocarbon Criteria Working Group. The surrogate approach involves the separation of the petroleum mixtures into aliphatic and aromatic equivalent carbon (EC)-range fractions (i.e., EC5 to EC8) and the use of surrogate compounds or derived values to represent the toxicity of those fractions (Ecology 1997). In general, the heavier the carbon fraction, the less toxic the compound. Using the toxicity criteria for the surrogate compounds, screening values can be calculated for each fraction using the EPA Region 9 method for calculating risk-based screening concentrations for exposures to noncarcinogenic contaminants in soils (USEPA 2000a).

After screening values are determined for the petroleum components and carbon fractions, a screening value for a product type (e.g., diesel-range petroleum hydrocarbon) can be derived by using the Ecology petroleum hydrocarbon product composition table. The Ecology table provides default product

compositions of aliphatic and aromatic carbon-range fractions (in percent by weight) for weathered gasoline, weathered diesel, and mineral oil. Multiplying each fraction's screening value by its corresponding product composition percentage and summing the results gives a screening value for a product type (e.g., weathered diesel). A screening value for weathered diesel protective of the residential child scenario was calculated to be 46,421 mg/kg using this methodology. The maximum diesel concentration detected at the former NPD laboratory site is 31,200 mg/kg, much less than this screening value protective of residential exposures. Thus, diesel is not likely to be present in concentrations that warrant a health concern at this site. Also, the maximum motor oil concentration was 10,600 mg/kg, which is also less than the weathered diesel screening value. Taking into consideration that motor oil is a heavier petroleum hydrocarbon compound, and therefore generally less toxic than diesel, motor oil is not likely present in concentrations that warrant a health concern at this site.

In conclusion, screening values for diesel-range and motor-oil-range petroleum hydrocarbons do not require calculation because these compounds are likely not present at concentrations that are a health concern.

- Because of the chemical structure and physical properties of 2-hexanone, its toxicity is likely similar to that of 2-butanone. The maximum detected concentration of 2-hexanone in soil of 3.14 mg/kg is significantly less than screening value for 2-butanone of 28,000 mg/kg. Thus, it is unlikely that 2-hexanone is present in concentrations that would warrant a health concern.

4.4.5 Selection of Screening Values

Based on the results of the evaluation thus far, nine chemicals were identified in the screening process as COPCs that could potentially represent a health risk at the site. The six COPCs identified for soil are Aroclor® 1254, three PAHs (benzo[a]anthracene, benzo[a]pyrene, and benzo[b]fluoranthene), arsenic, and iron. The three COPCs identified for groundwater are carbon tetrachloride, arsenic, and antimony. The purpose of this assessment is to identify screening values for these nine chemicals. The following sections discuss the selection of appropriate screening values for these COPCs in soil and groundwater.

Soil

Of the six COPCs that exceeded generic risk-based levels, either individually or because of additivity concerns, only arsenic and benzo(a)pyrene were selected as chemicals requiring screening values because their maximum detected concentrations exceeded their respective generic screening values. The other four COPCs (Aroclor® 1254, benzo[a]anthracene,

benzo[b]fluoranthene, and iron) were initially selected on the basis of potential additive health effects within soil, but their maximum concentrations do not exceed their individual risk-based levels. For noncarcinogens, only chemicals with similar toxic end points have additivity concerns. By convention, carcinogens are always assumed to be additive. Therefore, the carcinogens arsenic, Aroclor® 1254, and the three PAHs should have cleanup levels because of the potential additivity of cancer effects, although only arsenic and benzo(a)pyrene exceed a risk-based screening value. Table 4-9 lists the target organs affected by each of these chemicals and notes whether the effect of concern is cancer or noncancer. Iron is unlikely to present a health concern at the site and does not require a screening value because (1) iron is not a carcinogen, (2) its target organ is not the same as that for any other chemical, and (3) its maximum concentration did not exceed its risk-based screening level.

The EPA Region 9 PRGs developed for industrial exposures to soils are sufficiently protective of site conditions. Industrial soil PRGs are protective of the ingestion, inhalation, and dermal contact pathways assuming an exposure frequency of 5 days per week, 50 weeks per year, for 25 years. For this site, exposures to site soils would generally be much less than the conditions assumed by the EPA Region 9 PRGs and are unlikely to be more. Soil exposures by future occupants of the existing building (i.e., teachers and students of the community college) would likely not occur daily for 25 years because instructors generally do not teach 40 hours per week and students will be at the college only for a limited amount of time. Future construction workers would be exposed only during a relatively short-term project (EPA default construction project is 1 year [USEPA 2001]). Therefore, calculation of site-specific screening values is not considered necessary at this site and the use of the EPA Region 9 industrial soil PRGs are recommended for use as soil screening values at this site. The five soil COPCs for which screening values are required and their associated EPA Region 9 PRGs are summarized on Table 4-10.

Groundwater

Of the three COPCs that exceeded existing screening criteria either individually or due to additive effects, only carbon tetrachloride and arsenic were selected as COPCs because their maximum detected concentrations exceeded their screening levels. The other COPC in groundwater, antimony, was selected on the basis of potential additive health effects within groundwater if the water was used for drinking. Groundwater screening values are not warranted for any of these chemicals because of their isolated detections and because the groundwater at the site is not currently and will not in the future be used for drinking. Likely exposures to groundwater are limited to the vapor intrusion pathways: inhalation of groundwater vapors in indoor air by building occupants and inhalation of groundwater vapors in ambient air by construction workers as they perform subsurface work. Therefore, these pathways are complete only for the volatile chemicals, and there is no complete pathway of exposure to arsenic and antimony in groundwater. In addition, while concentrations of arsenic exceeded the PRG and

AWQC, neither arsenic nor antimony had any exceedances over the MCLs, the legal limits for chemicals in drinking water.

The volatile COPC, carbon tetrachloride, was detected once at 1 location out of the 15 samples used in this evaluation. The single detection was in the groundwater sample from the drainage ditch, which received untreated discharge from the laboratory operations. Carbon tetrachloride slightly exceeds the respective PRG and AWQC but not the MCL. The single detection of this chemical is an isolated occurrence and is not prevalent site-wide. Thus, the presence of this COPC at this site is not likely a health concern and no screening values are required to protect human health.

4.4.6 Human Health Risk Evaluation Summary

Past laboratory activities have resulted in the presence of selected chemicals in soil and groundwater at concentrations above generic risk-based screening levels. This presence indicates that potential health risks from exposures to these chemicals on the site could exist. Screening values were selected for chemicals that exceeded risk-based levels and might pose a health risk within the context of site-specific exposure conditions on the property.

The likeliest human exposure pathways at this site for soil were incidental ingestion and inhalation of fugitive dusts by occupants of the existing building (i.e., teachers and adult students of the community college) and short-term exposures to soil by future construction workers. Groundwater at this site is not currently being used as a drinking water source, and a deed restriction on the groundwater at the site will prevent its use as a drinking water source in the future. Therefore, exposures to groundwater are limited to the vapor intrusion pathways (volatile chemicals only), including inhalation of groundwater vapors in indoor air by building occupants and inhalation of groundwater vapors in ambient air by construction workers as they perform subsurface work.

In accordance with ODEQ (2000) guidelines, detected chemicals were screened on the basis of frequency of detection, exceedance over site background concentrations, and exceedance over generic risk-based screening criteria to determine whether they qualify as COPCs. In accordance with the guidance, the concentration-risk screen considered the potential for risk to be posed by exposure to (a) individual COPCs in an individual medium, (b) multiple COPCs within a given medium (i.e., cumulative risk), and (c) individual or multiple COPCs within different media. Maximum detected concentrations of chemicals in soil were compared to EPA Region 9 industrial soil PRGs. Maximum detected concentrations of chemicals in groundwater were compared to EPA Region 9 tap water PRGs, EPA MCLs, and EPA AWQCs. Chemicals whose maximum detected concentrations exceeded these screening levels were selected as COPCs.

A total of 15 chemicals in soil and 8 chemicals in groundwater were selected as COPCs in accordance with the ODEQ screening procedures. The majority of these chemicals (i.e., eight in soil and five in groundwater) were selected by default because they do not have screening criteria. However, the chemicals without screening criteria are unlikely to represent a health risk due either to their status as essential nutrients (low toxicity to humans) or their low concentrations when compared to risk-based levels for similar chemicals. Of the chemicals for which risk-based screening levels are available, screening values were selected for five chemicals in soil: Aroclor® 1254, arsenic, benzo(a)pyrene, benzo(a)anthracene, and benzo(b)fluoranthene. People using the site (teachers, students, construction workers) will not be exposed to site chemicals at exposure rates greater than those assumed for EPA Region 9 industrial soil PRGs. Therefore, the industrial soil PRGs are sufficiently protective of site exposures for the five COPCs in soil, and the calculation of site-specific screening values is not warranted. Any remaining concentrations of these chemicals below industrial PRGs will not pose a health risk. All of these chemicals are relatively immobile in soil and would not be expected to move into groundwater (Section 4.5.1).

No screening values are considered necessary to protect human health for chemicals in groundwater because the presence of detected COPCs at this site are not health concerns. Only carbon tetrachloride and arsenic exceeded a risk-based concentration based on use of the groundwater for drinking, while antimony was a potential concern due to additive effects. Groundwater will not be used as drinking water, and no MCLs were exceeded. Only the microwell near the drainage ditch had detected concentrations of the groundwater COPC carbon tetrachloride. This chemical is not prevalent in groundwater throughout the site and is isolated to this sample area.

4.5 OCCURRENCE OF CONTAMINATION

4.5.1 Contaminant Fate and Transport

The conceptual site model depicts potential transport pathways through which released contaminants may migrate. Secondary release mechanisms associated with the site include the following:

- Leaching and infiltration from soil into groundwater
- Discharge of groundwater into sediment and surface water

The results of the human health screening assessment found that only Aroclor® 1254, arsenic, benzo(a)pyrene, benzo(a)anthracene, and benzo(b)fluoranthene in soil are present at the site in concentrations that are a potential concern to human health. Migration of chemicals in one medium (i.e., soil) to another (i.e., groundwater) is a potential concern. However, based on site

characteristics and topography, Aroclor® 1254, arsenic, and the PAHs are expected to be relatively immobile due to their strong binding affinity to soil, low water solubility, and low vapor pressure. Therefore, the concentrations of these chemicals in soil are not likely to affect groundwater (or other environmental medium) in the future. The specific physical/chemical properties of Aroclor® 1254, arsenic, and the PAHs affecting their environmental fate and transport are summarized below.

Aroclor® 1254

Aroclor® 1254 is a member of the PCB chemical class and contains upwards of 200 individual compounds, all with a basic double-carbon ring structure with variable numbers of chlorines. PCB hydrocarbon mixtures are highly stable compounds, and their environmental fate and transport is largely determined by their low water solubility and corresponding high organic affinity. PCB hydrocarbon mixtures bind strongly to organic matter in soils and are not very subject to leaching into groundwater; thus, they do not migrate readily (ATSDR 1997b).

Arsenic

The principal physical states of arsenic of environmental importance are trivalent and pentavalent inorganic arsenic, and various forms of organic arsenic. The main source of naturally occurring arsenic is the pentavalent form in the ore: arsenopyrite (FeAsS). Arsenic trioxide (As_2O_3) has relatively low water solubility but dissolves in acidic or alkaline solutions. Pentavalent arsenic (As_2O_5) is more soluble in water than the trivalent state. The stability of these two valency forms is dependent on the medium. Oxygenated media and higher pH favor the pentavalent form, while reducing and/or acidic media favor the trivalent form (ATSDR 1993).

Arsenic in soil may be transported by wind or water erosion of small particles, or may be transported by leaching into rainfall or snowmelt. However, because many arsenic compounds tend to adsorb to soils or sediments, leaching usually results in transportation over only short distances in soil (ATSDR 1993).

PAHs

PAHs are a class of compounds that are formed during the incomplete combustion or pyrolysis of materials containing hydrogen and carbon. They also occur naturally in fossil fuels and in cooled or burned material. Benzo(a)pyrene is the PAH compound with the most environmental fate information (USEPA 1984). In the atmosphere, it is thought to exist primarily in the particulate sorbed phase. Benzo(a)pyrene has a low water solubility and is highly lipophilic (ATSDR 1995). As a result, these types of chemicals would be expected to bioaccumulate in fatty tissues of organisms. The primary mechanism for the removal of PAHs in soil is by

microbial degradation, and half-life values of PAHs in soil are reported to range from less than 1 day to a few years (USEPA 1984). Because of their high soil sorption coefficient and low water solubility, these compound are expected to have low mobility in soils. Significant leaching into groundwater is therefore not expected, especially from soils with high organic carbon content (USEPA 1984).

4.5.2 Comparison of Risk-Based COPCs in Soil to Screening Values

According to the human health risk evaluation, five COPCs (Aroclor® 1254, arsenic, benzo[a]pyrene, benzo[a]anthracene, and benzo[b]fluoranthene) are present in site soil at concentrations that are a potential concern to human health. The evaluation concluded that the EPA Region 9 industrial soil PRGs are sufficient to protect human health; therefore, calculation of site-specific screening values is not required. The sampling locations and detected concentrations of these exceedances are presented in Table 4-11. Concentrations for only two of the five compounds (benzo[a]pyrene and arsenic) exceed the PRG screening values in the soil samples. As discussed in the beginning of Section 4.4, the concrete and sump sediment samples were excluded from the human health risk evaluation because they have been removed from the site.

4.5.3 Occurrence of Contamination

This section combines the findings of the human health risk evaluation, properties of chemical fate and transport, comparison of analytical results to risk-based screening values, future land use, and site conditions to assess whether contamination that may pose a risk to human health exists at the site.

Sediment in Concrete Sump

Concentrations of arsenic, chromium, and Aroclor® 1242 in the sediment in the concrete sump exceed the respective PRGs (Table 2-14). Arsenic was detected at a concentration of 23.7 mg/kg (23.4 mg/kg, duplicate), which exceeds the PRG of 2.7 mg/kg. These concentrations are a maximum of 10 times greater than the site, RMC, or Clark County background values used during this investigation. Detections of chromium (101 mg/kg [99.4 mg/kg duplicate]) in the sediment slightly exceed the PRG of 64 mg/kg. These concentrations of chromium are approximately 4 times greater than the regional background value (26.57 mg/kg) and more than 10 times greater than the local background levels. The main contaminant detected in the sediment is Aroclor® 1242, which was detected at a concentration of 6,060 µg/kg (3,920 µg/kg duplicate), which exceeds the PRG of 1,000 µg/kg.

As stated previously, no complete exposure pathways exist for the sediment in the sump, so possible associated human health risks were limited and unlikely. However, the sediment was

removed and the sump decontaminated in February 2003, so possible human health risks associated with contaminants in the sediment have been completely eliminated.

Laboratory

Concentrations detected in soil collected from the vicinity of the laboratory were extremely low and significantly less than regulatory screening values. No concentrations of contaminants detected in the cleanout pipe, drainage ditch, dry well, or any locations near the laboratory building and concrete sump exceed their applicable PRGs. These infrequent occurrences indicate that systematic contamination or substantial release from the former laboratory practices does not exist. Mount Hood Community College, the potential future land owner, has indicated that the building and surrounding pavement will remain in place; therefore it is reasonable to assume that the building and pavement would provide adequate protection for potential exposure from the few contaminants and low concentrations known to exist. The low level of contamination combined with the intended future land use of the site indicate that the data do not pose a risk to human health.

Fuel Oil Tank Vault

One COPC (benzo[a]pyrene) was detected in soil collected from beneath the former fuel oil tank at a concentration of 1,260 µg/kg (1,960 µg/kg, duplicate), which exceeds the PRG of 290 µg/kg (Table 2-14). As indicated previously, asphalt fragments present in the sample that may have been remnants of the tank removal activities could be interfering with representative results of the sample. Soil surrounding the former tank removal excavation does not pose a potential risk to human health or the environment, and benzo(a)pyrene is not expected to be present in groundwater for several reasons:

- According to the tank removal report (USACE 1998), results of confirmation soil samples collected from outside the concrete vault indicate that the contaminated soil encountered was limited to within the vault. These sample results also indicate that contamination did not exist beneath the former tank location.
- Because soil surrounding the former tank excavation is protected by asphalt pavement, human exposure is limited.
- Because infiltration of groundwater and leaching of the contaminant is prevented by asphalt pavement on the ground surface, mobility of contaminants is very unlikely.
- As discussed in Section 4.5.1, because of a high soil sorption coefficient and low water solubility, this compound is not expected to be mobile.

- No VOCs, SVOCs, pesticides, PCB hydrocarbon mixtures, or cyanide were detected in nearby downgradient monitoring wells MW-2 and MW-3.

Landfill

Concentrations of benzo(a)pyrene and arsenic detected in the landfill material exceed the respective PRGs (Table 2-14) in the following locations:

- **Concrete Drums in Landfill.** Arsenic was detected in the representative sample of the concrete drums at an estimated concentration of 21.1 mg/kg (20.1 mg/kg, duplicate), which exceeds the PRG of 2.7 mg/kg. These concentrations are a maximum of 10 times greater than the site, RMC, or Clark County background values used during this investigation.

Numerous drums containing solidified concrete on the landfill surface and uncovered during trenching were removed from the landfill and disposed of offsite. It is possible that additional drums remain in the landfill, but it is assumed that most of the drums were visible on the surface and therefore removed.

- **Landfill North Toe.** The concentrations of benzo(a)pyrene detected at three of the four sampling locations at the landfill north toe exceed the PRG of 290 µg/kg. The concentrations detected at these three locations range from 316 µg/kg to 906 µg/kg. Arsenic was detected in the fourth landfill north toe soil sample at an estimated concentration (4.51 mg/kg) that slightly exceeds the PRG of 2.7 mg/kg.
- **Landfill Trenches TR-1 through TR-4.** Benzo(a)pyrene is present in the landfill material soil at trench TR-2 at a concentration of 438 µg/kg, which exceeds the PRG of 290 µg/kg. This compound was detected at a much lower concentration of 147 µg/kg in the duplicate. Also, this compound was not detected at concentrations that exceed the PRG in the native material at the base of this trench or in any of the remaining landfill trench samples.

The concentrations of arsenic detected at four of the five landfill trenches slightly exceed the PRG of 2.7 mg/kg. In trenches TR-1 through TR-4, arsenic was detected in the samples of the landfill material at concentrations ranging from 3.0 mg/kg to 8.0 mg/kg. Arsenic was detected in the native material sample from trench TR-2 at a concentration of 3.0 mg/kg. Most of these detections of arsenic are less than the Clark County regional background value (5.81 mg/kg) but greater than site or RMC background values for arsenic.

- **Landfill Trench TR-5.** One VOC (1,2-dibromoethane) was detected in the sample from this trench at a concentration (111 µg/kg, estimated) that exceeds the PRG of 48 µg/kg. This compound was not identified as a COPC. None of the identified COPCs were detected in trench TR-5 samples at concentrations that exceed the respective PRGs.

As indicated in Section 4.5.1, neither benzo(a)pyrene nor arsenic is expected to be mobile in the soil or to infiltrate to groundwater. All drums containing solidified concrete that were uncovered and all the material excavated from trench TR-5 were removed during this SI, and all landfill materials will be removed in the summer of 2003. This removal action will virtually eliminate possible health risks associated with the landfill.

Groundwater

As indicated in Section 2.4.2 and Table 2-15, total and dissolved arsenic and carbon tetrachloride were detected in groundwater at concentrations that exceed the PRG and AWQC. None of the detected analytes in groundwater exceeds the MCL, and the groundwater will not be used as drinking water because of a deed restriction.

Dissolved arsenic was detected in samples from 10 of the 11 sampling locations at concentrations that exceed screening values. However, the results of the human health risk evaluation indicate that there is no complete exposure pathway for arsenic in groundwater and so it does not pose a health risk. Carbon tetrachloride was detected once in one sample from one location. This single detection of this chemical is an isolated occurrence and is not prevalent site-wide. Thus, the isolated presence of this contaminant in groundwater at this site clearly is not a health concern under current potential exposure scenarios.

As discussed in Section 4.1.2, the groundwater sampling network was adequate for assessing groundwater quality beneath the site, and it has been adequately characterized to conclude that groundwater does not pose a risk to human health or the environment.

Table 4-1
Summary of Groundwater Elevations and Directions

Document	Measurement Date	Measurement Points	Range of Groundwater Elevation (feet msl)	Groundwater Flow Direction
Final EBS (Tetra Tech 1997)	September 1997	Soil borings	24.3 to 25.9	North-northwest
Final Supplemental Groundwater Investigation (Tetra Tech 1998)	April 1998	MW-1 through MW-6	27.95 to 29.14	West-southwest
Final Supplemental Groundwater Investigation (Tetra Tech 1998)	May 1998	MW-1 through MW-6	27.29 to 28.08	West-southwest
Final Cleanup Report (Tetra Tech 1999)	February 1999	MW-1 through MW-6	29.41 to 30.95	Generally west (ranging from southwest to northwest)
--	September 5, 2001	MW-1 through MW-6	19.76 to 23.27	North-northwest
--	September 15, 2001	MW-1 through MW-6 and temporary microwells	22.82 to 26.53	Generally north with localized flow beneath south portion of site toward the west, north, and east
--	April 9, 2003	MW-1 through MW-6	31.03 to 31.97	Nearly flat with slight flow toward south; localized flow beneath landfill toward west, south, and southeast

Notes:

EBS - environmental baseline survey

msl - mean sea level

-- - current investigation

Table 4-2
Soil and Groundwater Samples Used in
the Human Health Risk Evaluation

Soil Samples			Groundwater Samples
SS-003-01	SS-013-10	SS-028-05	MC-001
SS-003-05	SS-013-12	SS-028-11	MC-002
SS-004-03	SS-014-04	SS-029-05	MC-003
SS-004-09	SS-015-05	SS-029-10	MC-004
SS-005-01	SS-016-05	SS-030-10	MC-005
SS-006-01	SS-017-01	SS-031-10	MW-002
SS-006-05	SS-018-01	SS-033-01	MW-003
SS-007-01	SS-019-01	SS-033-04	MW-004
SS-007-05	SS-020-01	SS-001-01 ^a	MW-005
SS-008-01	SS-021-04	SS-001-12 ^a	MW-006
SS-008-05	SS-022-01	SS-002-01 ^a	MW-001 ^a
SS-009-08	SS-023-01	SS-032-01 ^a	
SS-009-11	SS-024-01	SS-032-14 ^a	
SS-010-08	SS-025-01		
SS-010-12	SS-026-04		
SS-011-08	SS-026-05		
SS-011-11	SS-026-07		
SS-012-08	SS-027-04		
SS-012-11	SS-027-13		

^a These samples are considered most representative of background conditions and were used in the background screening evaluation.

Table 4-3
Frequency of Detection - Soil

CAS Number	Detected Chemicals	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum Concentration	Range of Reporting Limits	Number of Detections / Number of Samples Analyzed	Frequency of Detection	COI Flag
VOCs								
71-55-6	1,1,1-Trichloroethane	0.000415	0.00679	SS-026-05	0.000273-0.000948	7/42	17%	YES
79-34-5	1,1,2,2-Tetrachloroethane	0.0386 J	0.0386 J	SS-033-01	0.000246-0.000948	1/42	2.4%	NO
106-93-4	1,2-Dibromoethane	0.111 J	0.111 J	SS-033-01	0.000246-0.000948	1/42	2.4%	NO
95-50-1	1,2-Dichlorobenzene	0.000627 J	0.000627 J	SS-033-01	0.000246-0.000948	1/42	2.4%	NO
541-73-1	1,3-Dichlorobenzene	0.161 J	0.161 J	SS-033-01	0.000246-0.000948	1/42	2.4%	NO
106-46-7	1,4-Dichlorobenzene	0.00193 J	0.00193 J	SS-033-01	0.000246-0.000948	1/42	2.4%	NO
78-93-3	2-Butanone	0.000714 J	0.213 J	SS-033-01	0.00158-0.00371	27/42	64.3%	YES
591-78-6	2-Hexanone	0.00112 J	3.14 J	SS-033-01	0.00123-0.00474	6/42	14.3%	YES
91-57-6	2-Methylnaphthalene	0.00146	7.74	SS-033-01	0.0011-0.0132	8/42	19.0%	YES
108-10-1	4-Methyl-2-pentanone	0.00136 J	0.00136 J	SS-013-12	0.00123-0.00474	1/42	2.4%	NO
83-32-9	Acenaphthene	0.00157	0.289	SS-023-01	0.00111-0.139	8/42	19.0%	YES
208-96-8	Acenaphthylene	0.00185	0.0587	SS-025-01	0.00111-0.139	9/42	21.4%	YES
67-64-1	Acetone	0.0133 J	1.28 J	SS-033-01	0.0026-0.0581	16/42	38.1%	YES
120-12-7	Anthracene	0.00185	0.712	SS-021-04	0.0011-0.139	11/42	26.2%	YES
71-43-2	Benzene	0.000358	0.0157	SS-025-01	0.000246-0.000741	15/42	35.7%	YES
92-52-4	Biphenyl	0.00252 J	0.0107 J	SS-027-04	0.0111-1.39	3/42	7.1%	YES
74-83-9	Bromomethane	0.000465	0.0102 J	SS-033-01	0.000246-0.000948	2/42	4.8%	NO
75-15-0	Carbon disulfide	0.00159 J	0.0388 J	SS-025-01	0.000273-0.000741	18/42	42.9%	YES
56-23-5	Carbon tetrachloride	0.0104	0.0104	SS-027-13	0.000246-0.000948	1/42	2.4%	NO
108-90-7	Chlorobenzene	0.0147 J	0.0147 J	SS-033-01	0.000246-0.000948	1/42	2.4%	NO
74-87-3	Chloromethane	0.000199 J	0.000199 J	SS-021-04	0.000246-0.000948	1/41	2.4%	NO
74-90-8	Cyanide	0.22	0.3	SS-033-01	0.2	2/41	4.9%	NO
132-64-9	Dibenzofuran	0.0252	0.162	SS-023-01	0.0111-1.39	4/42	9.5%	YES
75-71-8	Dichlorodifluoromethane	0.000271 J	0.00101	SS-033-04	0.000246-0.000948	4/41	9.8%	YES
100-41-4	Ethylbenzene	0.000247 J	0.0853 J	SS-033-01	0.000246-0.000948	4/42	9.5%	YES
86-73-7	Fluorene	0.00133	0.294	SS-021-04	0.00111-0.139	8/42	19.0%	YES
98-82-8	Isopropylbenzene	0.00769 J	0.00769 J	SS-033-01	0.000246-0.000948	1/42	2.4%	NO
1330-20-7	m,p-Xylene	0.0012 J	0.139 J	SS-033-01	0.000492-0.00168	5/42	11.9%	YES
79-20-9	Methyl acetate	0.00262 J	0.0336 J	SS-013-12	0.00246-0.00841	7/42	16.7%	YES

Table 4-3
Frequency of Detection - Soil

CAS Number	Detected Chemicals	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum Concentration	Range of Reporting Limits	Number of Detections / Number of Samples Analyzed	Frequency of Detection	COI Flag
VOCs (continued)								
108-87-2	Methylcyclohexane	0.000132 J	0.6 J	SS-033-01	0.000193-0.000948	5/42	11.9%	YES
75-09-2	Methylene chloride	0.0017	0.0017 J	SS-033-01	0.000487-0.0285	1/42	2.4%	NO
91-20-3	Naphthalene	0.0688	43.4	SS-033-01	0.000574-0.0835	2/42	4.8%	NO
95-47-6	o-Xylene	0.000525 J	0.0608 J	SS-033-01	0.000246-0.000841	5/42	11.9%	YES
85-01-8	Phenanthrene	0.00135	2.8	SS-021-04	0.00111-0.139	15/42	35.7%	YES
129-00-0	Pyrene	0.00181	3.06	SS-021-04	0.00111-0.139	17/42	40.5%	YES
100-42-5	Styrene	0.0468 J	0.0468 J	SS-033-01	0.000246-0.000948	1/42	2.4%	NO
108-88-3	Toluene	0.00304	0.056 J	SS-033-01	0.000239-0.00354	2/42	4.8%	NO
79-01-6	Trichloroethene	0.000215 J	0.00212	SS-027-13	0.000246-0.00304	2/42	4.8%	NO
75-69-4	Trichlorofluoromethane	0.000593	0.0189	SS-005-01	0.000273-0.000841	7/42	16.7%	YES
SVOCs								
108-39-4	3- & 4-Methylphenol	0.00475 J	0.00475 J	SS-027-04	0.011-1.39	1/41	2.4%	NO
72-54-8	4,4'-DDD	0.00125 J	0.00125 J	SS-024-01	0.0019-0.00219	1/41	2.4%	NO
72-55-9	4,4'-DDE	0.000861	0.00879	SS-024-01	0.0019-0.00219	2/41	4.9%	NO
50-29-3	4,4'-DDT	0.000558	0.0254	SS-024-01	0.0019-0.00218	6/41	14.6%	YES
11097-69-1	Aroclor 1254	0.00477 J	0.904	SS-033-01	0.00965-0.011	10/45	22.2%	YES
11096-82-5	Aroclor 1260	0.00926 J	0.111	SS-033-01	0.0095-0.011	3/45	6.7%	YES
56-55-3	Benzo(a)anthracene	0.0145	1.22	SS-021-04	0.00222-0.278	13/42	31.0%	YES
50-32-8	Benzo(a)pyrene	0.00133	1.26	SS-021-04	0.00111-0.139	16/42	38.1%	YES
205-99-2	Benzo(b)fluoranthene	0.00121	0.83	SS-021-04	0.00111-0.139	13/42	31.0%	YES
191-24-2	Benzo(g,h,i)perylene	0.00316	0.398	SS-021-04	0.00111-0.139	13/42	31.0%	YES
207-08-9	Benzo(k)fluoranthene	0.00216	0.358	SS-021-04	0.00111-0.139	10/42	23.8%	YES
65-85-0	Benzoic acid	0.0247 J	0.174 J	SS-022-01	0.0278-3.48	3/42	7.1%	YES
117-81-7	bis(2-Ethylhexyl)phthalate	1.41	1.41	SS-027-04	0.0139-3.48	1/42	2.4%	NO
85-68-7	Butylbenzylphthalate	0.00307 J	0.0053 J	SS-007-05	0.00253-1.39	5/42	11.9%	YES
218-01-9	Chrysene	0.0175	1.46	SS-021-04	0.00222-0.278	13/42	31.0%	YES
53-70-3	Dibenzo(a,h)anthracene	0.0122	0.0569	SS-027-04	0.000259-0.139	2/42	4.8%	NO
84-66-2	Diethylphthalate	0.00261 J	0.00261 J	SS-009-08	0.00261-1.39	1/42	2.4%	NO
206-44-0	Fluoranthene	0.00145	1.75	SS-023-01	0.00111-0.139	17/42	40.5%	YES
193-39-5	Indeno(1,2,3-cd)pyrene	0.0023	0.253	SS-021-04	0.00111-0.139	11/42	26.2%	YES
87-86-5	Pentachlorophenol	0.0121 J	1.12	SS-028-11	0.0111-1.39	2/41	4.9%	NO

Table 4-3
Frequency of Detection - Soil

CAS Number	Detected Chemicals	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum Concentration	Range of Reporting Limits	Number of Detections / Number of Samples Analyzed	Frequency of Detection	COI Flag
Metals								
7429-90-5	Aluminum	796 J	12700	SS-005-01	--	41/41	100.0%	YES
7440-36-0	Antimony	0.94 J	7.03 J	SS-028-11	8.89-11.7	17/41	41.5%	YES
7440-38-2	Arsenic	0.465	8.02	SS-028-05	0.267-0.319	16/41	39.0%	YES
7440-39-3	Barium	3.57	2580	SS-025-01	--	41/41	100.0%	YES
7440-41-7	Beryllium	0.153 J	0.317 J	SS-028-05	0.151-0.447	8/41	19.5%	YES
7440-43-9	Cadmium	0.187	1.41	SS-028-05	--	41/41	100.0%	YES
7440-70-2	Calcium	1020	30800 J	SS-026-04	--	41/41	100.0%	YES
7440-47-3	Chromium	2.62	38.3	SS-026-05	1.92-6.23	23/41	56.1%	YES
7440-48-4	Cobalt	0.751 J	29.1	SS-033-01	--	41/41	100.0%	YES
7440-50-8	Copper	6.57	97.7	SS-028-05	--	41/41	100.0%	YES
7439-89-6	Iron	2210	28500	SS-025-01	--	41/41	100.0%	YES
7439-92-1	Lead	0.227	266 J	SS-025-01	--	41/41	100.0%	YES
7439-95-4	Magnesium	122 J	7540	SS-026-04	--	41/41	100.0%	YES
7439-96-5	Manganese	18.2	617	SS-028-05	--	41/41	100.0%	YES
7487-94-7	Mercury	0.0134 J	4.05 J	SS-003-01	0.0129-0.0215	32/41	78.0%	YES
7440-02-0	Nickel	1.09 J	54.2	SS-026-05	--	41/41	100.0%	YES
7440-22-4	Potassium	56.9 J	1170	SS-029-05	367	40/41	97.6%	YES
7782-49-2	Selenium	1.56 J	2.68 J	SS-028-05	1.21-10.7	10/41	24.4%	YES
7440-22-4	Silver	0.0255	0.771	SS-027-04	--	41/41	100.0%	YES
7440-23-5	Sodium	135 J	1370 J	SS-005-01	180-269	29/41	70.7%	YES
7440-24-6	Strontium	5.31 J	89.5	SS-028-11	--	41/41	100.0%	YES
7440-61-0	Uranium	0.0366	0.754	SS-029-05	--	41/41	100.0%	YES
7440-62-2	Vanadium	8.42	72.8	SS-025-01	--	41/41	100.0%	YES
7440-66-6	Zinc	3.69	433	SS-025-01	--	41/41	100.0%	YES
TPH								
NA	Diesel-range hydrocarbons	22.8 J	31200	SS-033-01	--	5/5	100.0%	YES
NA	Motor-oil-range hydrocarbons	117	10600	SS-033-01	--	5/5	100.0%	YES

Notes:

-- - This chemical was detected in 100% of the samples analyzed.
CAS - Chemical Abstract Service
COI - chemical of interest
J - value estimated

mg/kg - milligram per kilogram
SVOCs - semivolatile organic compounds
TPH - total petroleum hydrocarbons
VOCs - volatile organic compounds

Table 4-4
Frequency of Detection - Groundwater

CAS Number	Detected Chemicals	Minimum Detected Concentration (mg/L)	Maximum Detected Concentration (mg/L)	Location of Maximum Concentration	Range of Reporting Limits	Number of Detections / Number of Samples Analyzed	Frequency of Detection	COI Flag
VOCs								
71-55-6	1,1,1-Trichloroethane	0.454	0.454	MW-006	0.089-0.5	1/15	7%	YES
56-23-5	Carbon tetrachloride	0.281 J	0.281 J	MC-001	0.0684-0.5	1/15	7%	YES
85-01-8	Phenanthrene	0.0198	0.0629 J	MW-003	0.0021-0.02	2/15	13%	YES
127-18-4	Tetrachloroethene	0.331 J	0.331 J	MC-001	0.0722-0.5	1/15	7%	YES
SVOCs								
95-48-7	2-Methylphenol	0.249 J	0.249 J	MW-004	0.023-0.24	1/15	7%	YES
108-39-4	3- & 4-Methylphenol	2.8	2.8	MW-004	0.0217-0.23	1/15	7%	YES
65-85-0	Benzoic acid	0.13	0.584	MW-006	0.0189-0.542	2/13	15%	YES
100-51-6	Benzyl alcohol	0.558 J	0.558 J	MW-006	0.03-0.11	1/13	8%	YES
108-95-2	Phenol	0.497 J	0.497 J	MW-004	0.03-0.32	1/15	7%	YES
Metals								
7429-90-5	Aluminum	13.3	2570	MC-003	--	15/15	100%	YES
7440-36-0	Antimony	0.685 J	0.909 J	MW-004	0.0422-0.8	2/15	13%	YES
7440-38-2	Arsenic	0.136 J	1.86	MW-006	0.0758-5	3/15	20%	YES
7440-39-3	Barium	2.82	19.2	MW-003	0.2	10/15	67%	YES
7440-41-7	Beryllium	0.045 J	0.1 J	MC-004	0.044-0.809	5/15	33%	YES
7440-41-7	Cadmium	0.059 J	0.271 J	MC-003	0.0416-0.0833	6/15	40%	YES
7440-70-2	Calcium	2,800	85,100	MW-006	5170	14/15	93%	YES
7440-48-4	Cobalt	0.07 J	12.3	MW-004	0.5-1.36	12/15	80%	YES
7440-50-8	Copper	1.45	32	MC-003	2.3-3.92	9/15	60%	YES
7439-92-1	Iron	410	3980	MW-004	0.8-29.9	10/15	67%	YES
7439-91-1	Lead	0.11 J	3.12	MW-006	0.00657-0.035	11/15	73%	YES
7439-96-5	Magnesium	406 J	4910	MW-004	--	15/15	100%	YES
7439-96-5	Manganese	3.47 J	48.5	MW-004	0.322-3	13/15	87%	YES
7440-02-0	Nickel	0.538 J	10.7	MW-004	0.3-2.04	9/15	60%	YES
7440-09-07	Potassium	1160 J	4640	MW-004	--	15/15	100%	YES
7440-22-4	Silver	0.05 J	0.05 J	MC-003	0.0485-2	1/15	7%	YES
7440-23-5	Sodium	3760	48,400	MC-002	171	13/15	87%	YES
7440-24-6	Strontium	12.2 J	254	MW-006	--	15/15	100%	YES
7440-61-0	Uranium	0.134	0.157	MC-003	0.1-5	3/15	20%	YES
7440-62-2	Vanadium	3.68 J	20.1	MC-003	0.2-2.74	10/15	67%	YES
7440-66-6	Zinc	32.1	80.6	MW-003	0.3-14.9	2/15	13%	YES

Notes:

-- - This chemical was detected in 100% of the samples analyzed.

CAS - Chemical Abstract Service

COI - chemical of interest

J - value estimated

µg/L - microgram per liter

SVOCs - semivolatile organic compounds

TPH - total petroleum hydrocarbons

VOCs - volatile organic compounds

Table 4-5
Comparison of Site Metals Concentrations in Soil and Groundwater to Available Background Concentrations

Metals	Soil					Groundwater			
	Clark County, Washington Background Concentration (1) (mg/kg)	Range of Adjacent Site (Reynolds Metals) Background Concentrations (2) (mg/kg)	Range of Site Background Concentrations (3) (mg/kg)	Maximum Detected Site Concentration (4) (mg/kg)	Site Concentration Greater than the Range of Background Concentration?	Range of Adjacent Site (Reynolds Metals) Background Concentrations (2) (ug/L)	Site Background Concentrations (5) (ug/L)	Maximum Detected Site Concentration (6) (ug/L)	Site Concentration Greater than Background Concentration?
Aluminum	52276	7270-10500	1320 - 3030	12700	NO (7)	191-2,000	18.9-35.1	2,570	YES
Antimony	NE	<5.9	0.962 - 2.6	7.03	YES	<5	<1.41	0.909	YES
Arsenic	5.81	0.984-1.6	<0.343	8.02	YES	<4	0.541	1.86	YES
Barium	NE	22.8-63	4.42 - 19.4	2580	YES	26-32	2.95	19.2	NO
Beryllium	2.07	0.48	<0.458	0.317	NO	<20	<0.2	0.1	YES
Cadmium	0.93	<0.5	0.233 - 0.491	1.41	YES	<20	<0.0833	0.271	YES
Calcium	NE	2200-2860	1110 - 1530	30800	YES	8,500-12,000	6,110-12,500	85,100	YES
Chromium	26.57	7.7-11.5	6.26	38.3	YES	<20	<6.36	0.752	YES
Cobalt	NE	2.61-5.1	1.57 - 3.82	29.1	YES	<50	0.047	12.3	YES
Copper	34.43	9.32-18.9	10.3 - 14.5	97.7	YES	<20	2.04-17.6	32	YES
Iron	58665	8160-11800	3260 - 10100	28500	NO (7)	275-5,000	<64.6	3,980	NO
Lead	24.02	5.4-25.9	0.393 - 0.845	266	YES	<5	0.209	3.12	YES
Magnesium	NE	791-1590	222 - 492	7540	YES	2,600-5,300	731-1,440	4,910	NO
Manganese	1511	68.5-192	32.1 - 110	617	NO (7)	20-260	<3	48.5	NO
Mercury	0.04	0.8	0.017 - 0.034	4.05	YES	<0.5	<0.131	<0.131	NO
Nickel	21.04	5.9-9.6	1.89 - 3.83	54.2	YES	<100	0.465	10.7	YES
Potassium	NE	240-422	58.1 - 366	1170	YES	2,700-3,900	2,330-2,570	4,640	YES
Selenium	NE	<1	<11.4	2.68	NO	<5	0.346	<4	NO
Silver	NE	<1	0.045 - 0.086	0.771	YES	<20	<0.8	0.05	YES
Sodium	NE	363-670	205 - 357	1370	YES	5,800-7,100	11,800-14,000	48,400	YES
Strontium	NE	NE	5.91 - 18.7	89.5	YES	NE	39.8-44.1	254	YES
Uranium	NE	NE	0.068 - 0.136	0.754	YES	NE	<5	0.157	YES
Vanadium	NE	32.1-58.1	12.3 - 38.7	72.8	YES	<20	3.92-7.04	20.1	YES
Zinc	95.52	19.2-102	5.64 - 14.4	433	YES	<100	<6.78	80.6	YES

(1) The reported background soil concentrations are the 90th percentile values recorded for Clark County, Washington, as reported in *Natural Background Soil Metals Concentrations in Washington State, Washington State Department of Ecology, Toxics Cleanup Program. Publication No. 94-115. October 1994.*

(2) These background concentrations were obtained from the *Background Data Summary for RMC-Troutdale* (CH2M HILL 1996). This report investigated background concentrations in various media around the Reynolds Metals site, which is located approximately 1/4 mile north-northwest of the former NPD laboratory site. These background data are considered also representative of background conditions at the former NPD laboratory site. The soil background values in the table are the range of concentrations reported for upland surface soils, and the groundwater background values in the table are the range of background concentrations reported for shallow groundwater.

(3) The values in the table are the range of concentrations reported for the 5 background samples collected from the site.

(4) The values in the table are the maximum concentrations of metals detected in surface and subsurface soil.

(5) The values in the table are the concentrations of metals detected in MW-001.

(6) The values in the table are the maximum concentrations of metals detected in groundwater.

(7) The maximum detected concentration of these metals exceeded the background concentrations for the site and the adjacent site, but were below the regional background concentration for Clark County. These chemicals will be further evaluated in the screening process for COPCs.

Notes:

< - This metal was not detected in any sample. Concentrations of this metal are less than the highest sample quantitation limit (SQL).

COPCs - chemicals of potential concern

µg/L - microgram per liter

mg/kg - milligram per kilogram

NE - not established

Table 4-6
COPC Screening for Onsite Exposures to Chemicals in Soil

CAS Number	COI	Soil						Chemicals Without Available Screening Criteria	
		C _s (mg/kg)	PRG _{ind} (mg/kg)	R _{i-s}	COPC? ⁽¹⁾	R _{i-s} / R _s	COPC? ⁽²⁾	Criteria?	COPC ^{(3)?}
VOCs									
71-55-6	1,1,1-Trichloroethane	0.00679	1400	4.9E-06	NO	4.8E-07	NO	YES	NO
78-93-3	2-Butanone	0.213 J	280000	7.6E-07	NO	7.5E-08	NO	YES	NO
591-78-6	2-Hexanone	3.14 J	na	--	NO	--	NO	NO	YES
91-57-6	2-Methylnaphthalene (4)	7.74	190	4.1E-02	NO	4.0E-03	NO	YES	NO
83-32-9	Acenaphthene	0.289	38000	7.6E-06	NO	7.5E-07	NO	YES	NO
208-96-8	Acenaphthylene (4)	0.0587	38000	1.5E-06	NO	1.5E-07	NO	YES	NO
67-64-1	Acetone	1.28 J	6200	2.1E-04	NO	2.0E-05	NO	YES	NO
120-12-7	Anthracene	0.712	100000	7.1E-06	NO	7.0E-07	NO	YES	NO
71-43-2	Benzene	0.0157	1.5 c	1.0E-02	NO	1.0E-03	NO	YES	NO
92-52-4	Biphenyl	0.0107 J	350	3.1E-05	NO	3.0E-06	NO	YES	NO
75-15-0	Carbon disulfide	0.0388 J	720	5.4E-05	NO	5.3E-06	NO	YES	NO
132-64-9	Dibenzofuran	0.162	5100	3.2E-05	NO	3.1E-06	NO	YES	NO
75-71-8	Dichlorodifluoromethane	0.00101	310	3.3E-06	NO	3.2E-07	NO	YES	NO
100-41-4	Ethylbenzene	0.0853 J	230	3.7E-04	NO	3.7E-05	NO	YES	NO
86-73-7	Fluorene	0.294	33000	8.9E-06	NO	8.8E-07	NO	YES	NO
1330-20-7	m,p-Xylene (4)	0.139 J	210	6.6E-04	NO	6.5E-05	NO	YES	NO
79-20-9	Methyl acetate	0.0336 J	96000	3.5E-07	NO	3.5E-08	NO	YES	NO
108-87-2	Methylcyclohexane	0.6 J	8800	6.8E-05	NO	6.7E-06	NO	YES	NO
95-47-6	o-Xylene (4)	0.0608 J	210	2.9E-04	NO	2.9E-05	NO	YES	NO
85-01-8	Phenanthrene	2.8	na	--	NO	--	NO	NO	YES
129-00-0	Pyrene	3.06	54000	5.7E-05	NO	5.6E-06	NO	YES	NO
75-69-4	Trichlorofluoromethane	0.0189	2000	9.5E-06	NO	9.3E-07	NO	YES	NO
SVOCs									
50-29-3	4,4'-DDT	0.0254	12 c	2.1E-03	NO	2.1E-04	NO	YES	NO
11097-69-1	Aroclor 1254	0.904	1.0 c	9.0E-01	NO	8.9E-02	YES	YES	NO
11096-82-5	Aroclor 1260	0.111	1.0 c	1.1E-01	NO	1.1E-02	NO	YES	NO
56-55-3	Benzo(a)anthracene	1.22	2.9 c	4.2E-01	NO	4.2E-02	YES	YES	NO
50-32-8	Benzo(a)pyrene	1.26	0.29 c	4.3E+00	YES	4.3E-01	YES	YES	NO

Table 4-6
COPC Screening for Onsite Exposures to Chemicals in Soil

CAS Number	COI	Soil						Chemicals Without Available Screening Criteria	
		C _s (mg/kg)	PRG _{ind} (mg/kg)	R _{i-s}	COPC? ⁽¹⁾	R _{i-s} / R _s	COPC? ⁽²⁾	Criteria?	COPC ^{(3)?}
SVOCs (continued)									
205-99-2	Benzo(b)fluoranthene	0.83	2.9 c	2.9E-01	NO	2.8E-02	YES	YES	NO
191-24-2	Benzo(g,h,i)perylene	0.398	na	--	NO	--	NO	NO	YES
207-08-9	Benzo(k)fluoranthene	0.358	29 c	1.2E-02	NO	1.2E-03	NO	YES	NO
65-85-0	Benzoic acid	0.174 J	100000	1.7E-06	NO	1.7E-07	NO	YES	NO
85-68-7	Butylbenzylphthalate	0.0053 J	100000	5.3E-08	NO	5.2E-09	NO	YES	NO
218-01-9	Chrysene	1.46	290 c	5.0E-03	NO	5.0E-04	NO	YES	NO
206-44-0	Fluoranthene	1.75	30000	5.8E-05	NO	5.8E-06	NO	YES	NO
193-39-5	Indeno(1,2,3-cd)pyrene	0.253	2.9 c	8.7E-02	NO	8.6E-03	NO	YES	NO
Metals									
7429-90-5	Aluminum	12700	100000	1.3E-01	NO	1.3E-02	NO	YES	NO
7440-36-0	Antimony	7.03 J	820	8.6E-03	NO	8.5E-04	NO	YES	NO
7440-38-2	Arsenic	8.02	2.7 c	3.0E+00	YES	2.9E-01	YES	YES	NO
7440-39-3	Barium	2580	100000	2.6E-02	NO	2.5E-03	NO	YES	NO
7440-43-9	Cadmium	1.41	810	1.7E-03	NO	1.7E-04	NO	YES	NO
7440-70-2	Calcium	30800 J	na	--	NO	--	NO	NO	YES
7440-47-3	Chromium (5)	38.3	450 c	8.5E-02	NO	8.4E-03	NO	YES	NO
7440-48-4	Cobalt	29.1	100000	2.9E-04	NO	2.9E-05	NO	YES	NO
7440-50-8	Copper	97.7	76000	1.3E-03	NO	1.3E-04	NO	YES	NO
7439-89-6	Iron	28500	100000	2.9E-01	NO	2.8E-02	YES	YES	NO
7439-92-1	Lead (6)	266 J	750	3.5E-01	NO	--	NO	YES	NO
7439-96-5	Manganese	617	32000	1.9E-02	NO	1.9E-03	NO	YES	NO
7439-95-4	Magnesium	7540	na	--	NO	--	NO	NO	YES
7487-94-7	Mercury	4.05 J	610	6.6E-03	NO	6.6E-04	NO	YES	NO
7440-02-0	Nickel	54.2	41000	1.3E-03	NO	1.3E-04	NO	YES	NO
7440-22-4	Potassium	1170	na	--	NO	--	NO	NO	YES
7782-49-2	Selenium	2.68 J	10000	2.7E-04	NO	2.6E-05	NO	YES	NO
7440-22-4	Silver	0.771	10000	7.7E-05	NO	7.6E-06	NO	YES	NO
7440-23-5	Sodium	1370 J	na	--	NO	--	NO	NO	YES

Table 4-6
COPC Screening for Onsite Exposures to Chemicals in Soil

CAS Number	COI	Soil						Chemicals Without Available Screening Criteria	
		C _s (mg/kg)	PRG _{ind} (mg/kg)	R _{i-s}	COPC? ⁽¹⁾	R _{i-s} / R _s	COPC? ⁽²⁾	Criteria?	COPC ⁽³⁾ ?
Metals (continued)									
7440-24-6	Strontium	89.5	100000	9.0E-04	NO	8.8E-05	NO	YES	NO
7440-61-0	Uranium	0.754	410	1.8E-03	NO	1.8E-04	NO	YES	NO
7440-62-2	Vanadium	72.8	14000	5.2E-03	NO	5.1E-04	NO	YES	NO
7440-66-6	Zinc	433	100000	4.3E-03	NO	4.3E-04	NO	YES	NO
TPH									
NA	Diesel-range hydrocarbons	31200	na	--	NO	--	NO	NO	YES
NA	Motor-oil-range hydrocarbons	10600	na	--	NO	--	NO	NO	YES
		R _s 1.0E+01							
		N _s 51							
		1/N _s 0.020							

Notes:

- (1) COPC on an individual basis if $R_i > 1$.
(2) COPC on multiple basis in one medium if $R_i / R_{total} > 1/N$.
(3) COPC on basis of no available screening criteria.
(4) The following surrogate chemicals were used for screening values:
- | <u>Chemical Name</u> | <u>Surrogate Chemical</u> |
|----------------------|---------------------------|
| 2-Methylnaphthalene | Naphthalene |
| Acenaphthylene | Acenaphthene |
| m,p-Xylene | Xylenes |
| o-Xylene | Xylenes |
- (5) The PRG is based on total chromium (1:6 ratio CrVI:CrIII)
(6) Lead is evaluated separately from all other chemicals and is not screened based on chemical additivity.

-- - no risk ratio calculated
c - carcinogen
C_s - chemical concentration in soil
CAS - Chemical Abstract Service
COI - chemical of interest
COPC - chemical of potential concern
J - value estimated
mg/kg - milligram per kilogram
N_s - total number of risk ratios for chemicals in soil
na - not available
NA - not applicable
PRG_{ind} - EPA Region 9 industrial Preliminary Remediation Goals for soil
R_{i-s} - risk ratio for chemical *i* in soil (C_{ss}/PRG_{ind})
R_s - total risk ratio for soil

Table 4-7
COPC Screening for Onsite Exposures to Chemicals in Groundwater

CAS Number	COI	Groundwater ⁽⁵⁾												Chemicals Without Available Screening Criteria		
		C _{gw} (ug/L)	PRG _{TW} (ug/L)	MCL (ug/L)	AWQC ⁽¹⁾ (ug/L)	R _{i-gw} (PRG)	R _{i-gw} (MCL)	R _{i-gw} (AWQC)		COPC? ⁽²⁾	R _{i-gw} ^{PRG} / R _{gw} ^{PRG}	R _{i-gw} ^{MCL} / R _{gw} ^{MCL}	R _{i-gw} ^{AWQC} / R _{gw} ^{AWQC}	COPC? ⁽³⁾	Criteria?	COPC ^{(4)?}
VOCs																
71-55-6	1,1,1-Trichloroethane	0.454		540	200	NA	8.4E-04	2.3E-03	--	NO	1.9E-05	2.9E-03	--	NO	YES	NO
56-23-5	Carbon tetrachloride	0.281	J	0.17	5	0.25	1.7E+00	5.6E-02	1.1E+00	YES ⁽⁷⁾	3.8E-02	7.3E-02	1.1E-02	NO	YES	NO
85-01-8	Phenanthrene	0.0629	J	NA	NA	NA	--	--	--	NO	--	--	--	NO	NO	YES
127-18-4	Tetrachloroethene	0.331	J	1.1	5	0.8	3.0E-01	6.6E-02	4.1E-01	NO	6.9E-03	8.6E-02	3.9E-03	NO	YES	NO
SVOCs																
95-48-7	2-Methylphenol	0.249	J	1800	NA	NA	1.4E-04	--	--	NO	3.2E-06	--	--	NO	YES	NO
108-39-4	3- & 4-Methylphenol	2.8		180	NA	NA	1.6E-02	--	--	NO	3.6E-04	--	--	NO	YES	NO
65-85-0	Benzoic acid	0.584		150000	NA	NA	3.9E-06	--	--	NO	8.9E-08	--	--	NO	YES	NO
100-51-6	Benzyl alcohol	0.558	J	11000	NA	NA	5.1E-05	--	--	NO	1.2E-06	--	--	NO	YES	NO
108-95-2	Phenol	0.497	J	22000	NA	21000	2.3E-05	--	2.4E-05	NO	5.2E-07	--	2.3E-07	NO	YES	NO
Metals																
7429-90-5	Aluminum	2570		36000	NA	NA	7.1E-02	--	--	NO	1.6E-03	--	--	NO	YES	NO
7440-36-0	Antimony	0.909	J	15	6	14	6.1E-02	1.5E-01	6.5E-02	NO	1.4E-03	2.0E-01	6.2E-04	YES ⁽⁸⁾	YES	NO
7440-38-2	Arsenic	1.86		0.05	10	0.02	4.1E+01	1.9E-01	1.0E+02	YES ⁽⁹⁾	9.5E-01	2.4E-01	9.8E-01	YES ⁽⁹⁾	YES	NO
7440-41-7	Beryllium	0.1	J	73	4	NA	1.4E-03	2.5E-02	--	NO	3.1E-05	3.2E-02	--	NO	YES	NO
7440-41-7	Cadmium	0.271	J	18	5	NA	1.5E-02	5.4E-02	--	NO	3.5E-04	7.0E-02	--	NO	YES	NO
7440-70-2	Calcium	85,100		NA	NA	NA	--	--	--	NO	--	--	--	NO	NO	YES
7440-48-4	Cobalt	12.3		2200	NA	NA	5.6E-03	--	--	NO	1.3E-04	--	--	NO	YES	NO
7440-50-8	Copper ⁽⁵⁾	32		1400	1300	1300	2.3E-02	2.5E-02	2.5E-02	NO	5.2E-04	3.2E-02	2.3E-04	NO	YES	NO
7439-91-1	Lead ^(5,6)	3.12		NA	15	NA	--	2.1E-01	--	NO	--	--	--	NO	YES	NO
7440-02-0	Nickel	10.7		730	NA	610	1.5E-02	--	1.8E-02	NO	3.4E-04	--	1.7E-04	NO	YES	NO
7440-09-07	Potassium	4640		NA	NA	NA	--	--	--	NO	--	--	--	NO	NO	YES
7440-22-4	Silver	0.05	J	180	NA	NA	2.8E-04	--	--	NO	6.4E-06	--	--	NO	YES	NO
7440-23-5	Sodium	48,400		NA	NA	NA	--	--	--	NO	--	--	--	NO	NO	YES
7440-24-6	Strontium	254		22000	NA	NA	1.2E-02	--	--	NO	2.6E-04	--	--	NO	YES	NO
7440-61-0	Uranium	0.157		7.3	NA	NA	2.2E-02	--	--	NO	4.9E-04	--	--	NO	YES	NO
7440-62-2	Vanadium	20.1		260	NA	NA	7.7E-02	--	--	NO	1.8E-03	--	--	NO	YES	NO
7440-66-6	Zinc	80.6		11000	NA	9100	7.3E-03	--	8.9E-03	NO	1.7E-04	--	8.4E-05	NO	YES	NO
		R _{gw} 4.4E+01 7.7E-01 1.0E+02 N _{gw} 21 9 8 1/N _{gw} 0.048 0.111 0.125														

Table 4-7
COPC Screening for Onsite Exposures to Chemicals in Groundwater

- (1) The AWQC values listed on this table are protective of both the ingestion of water and the ingestion of fish pathways.
- (2) COPC on an individual basis if $R_i > 1$.
- (3) COPC on multiple basis in one medium if $R_i / R_{total} > 1/N$.
- (4) COPC on basis of no available screening criteria.
- (5) The copper and lead MCL screening values are based on EPA's action levels.
- (6) Lead is evaluated separately from all other chemicals and is not screened based on additivity.
- (7) Chemical selected as a COPC based on the screening against the PRG and the AWQC.
- (8) Chemical selected as a COPC based on the screening against the MCL.
- (9) Chemical selected as a COPC based on the screening against the PRG, MCL, and AWQC.

Notes:

- - no risk ratio calculated.
- AWQC - ambient water quality criteria
- C_{gw} - maximum chemical concentration in groundwater
- CAS - Chemical Abstract Service
- COI - chemical of interest
- COPC - chemical of potential concern
- J - value estimated
- MCL - maximum contaminant level
- ug/L - microgram per liter
- N_{gw} - total number of chemicals in groundwater
- NA - not applicable
- PRG_{tw} - EPA Region 9 industrial Preliminary Remediation Goal for tap water
- R_{i-ss} - risk ratio for chemical i in surface soil (C_{ss}/PRG_{ind})
- R_{i-gw} - risk ratio for chemical i in groundwater (C_{gw}/PRG_{TW})
- R_{gw} - total risk ratio for groundwater
- N_{gw} - total number of risk ratios for chemicals in groundwater
- R_{gw} - total risk ratio for groundwater

Table 4-8
Summary of Human Health Risk Evaluation Screening Results

Soil	Groundwater
2-Hexanone ^a	Calcium ^a
Aroclor 1254	Carbon tetrachloride
Arsenic	Antimony
Benzo(a)anthracene	Arsenic
Benzo(a)pyrene	Magnesium ^a
Benzo(b)fluoranthene	Phenanthrene ^a
Benzo(g,h,i)perylene ^a	Potassium ^a
Calcium ^a	Sodium ^a
Iron	
Magnesium ^a	
Phenanthrene ^a	
Potassium ^a	
Sodium ^a	
Diesel-range petroleum hydrocarbons ^a	
Motor-oil-range petroleum hydrocarbons ^a	

^a These chemicals were selected as COPCs because they have no available screening criteria. These chemicals will be discussed qualitatively as an area of uncertainty.

Table 4-9
Toxicity Endpoints for Selected COPCs

COPC	Toxicity Endpoint		Source
	Cancer	No-cancer	
Aroclor® 1254	Liver Cancer	Immunological Effects	USEPA 2002
Arsenic	Skin Cancer (oral exposures)	Dermatoses	USEPA 2002
Antimony	N/A	Longevity, Cholesterol Effects	USEPA 2002
Benzo(a)anthracene	Liver Cancer	N/A	USEPA 2002
Benzo(a)pyrene	Liver Cancer	N/A	USEPA 2002
Benzo(b)fluoranthene	Liver Cancer	N/A	USEPA 2002
Carbon tetrachloride	Liver Cancer	N/A	USEPA 2002
Iron	N/A	Hematological Effects	USEPA 1999a
Tetrachloroethene	Liver Cancer	N/A	USEPA 1998

Notes:

COPC - chemical of potential concern

N/A - not applicable

Table 4-10
Selected Screening Levels for COPCs in Soil

COPC	Screening Level (EPA Region 9 PRG for Industrial Soil)	
	(mg/kg)	(µg/kg)
Aroclor® 1254	1.0	1,000
Arsenic	2.7	2,700
Benzo(a)anthracene	2.9	2,900
Benzo(a)pyrene	0.29	290
Benzo(b)fluoranthene	2.9	2,900

Notes:

COPC - chemical of potential concern

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

PRG - Preliminary Remediation Goal

Table 4-11
Concentrations of Chemicals of Potential Concern in Soil and Comparison to Screening Values

Chemical of Potential Concern*	EPA Region 9 Industrial PRG	Drainage Ditch				Cleanout Pipe SS-016-05
		SS-003-01	SS-004-09	SS-005-01	SS-006-01	
SVOCs (mg/kg)						
Benzo(a)anthracene	2,900	30.8		15.9		
Benzo(a)pyrene	290	48.2		26.5	3.5	1.33
Benzo(b)fluoranthene	2,900	69.0	1.77	38.7	4.9	1.21
PCBs (mg/kg)						
Aroclor 1254	1,000	30.4				
Metals (mg/kg)						
Arsenic	2.7	1.15		1.04	0.456	

Chemical of Potential Concern*	EPA Region 9 Industrial PRG	Transformer Pad				
		SS-017-01	SS-018-01	SS-019-01	SS-319-01 Duplicate	SS-020-01
SVOCs (mg/kg)						
Benzo(a)anthracene	2,900					
Benzo(a)pyrene	290					
Benzo(b)fluoranthene	2,900					
PCBs (mg/kg)						
Aroclor 1254	1,000	7.0 J	26	56	52	130
Metals (mg/kg)						
Arsenic	2.7					

Chemical of Potential Concern*	EPA Region 9 Industrial PRG	Fuel Oil Tank Vault	
		SS-021-04	SS-321-04 Duplicate
SVOCs (mg/kg)			
Benzo(a)anthracene	2,900	1,220	1,470
Benzo(a)pyrene	290	1,260	1,960
Benzo(b)fluoranthene	2,900	830	1,120
PCBs (mg/kg)			
Aroclor 1254	1,000		
Metals (mg/kg)			
Arsenic	2.7		

Table 4-11
Concentrations of Chemicals of Potential Concern in Soil and Comparison to Screening Values

Chemical of Potential Concern*	EPA Region 9 Industrial PRG	Landfill North Toe				
		SS-022-01	SS-023-01	SS-323-01 Duplicate	SS-024-01	SS-025-01
SVOCs (mg/kg)						
Benzo(a)anthracene	2,900	202	564	231	236	129
Benzo(a)pyrene	290	482	906	283	316	214
Benzo(b)fluoranthene	2,900					167
PCBs (mg/kg)						
Aroclor 1254	1,000				26.5	
Metals (mg/kg)						
Arsenic	2.7	1.46 J	2.30 J	1.90 J	2.22 J	4.51 J

Chemical of Potential Concern*	EPA Region 9 Industrial PRG	Landfill Trench TR-1		Landfill Trench TR-2		
		SS-026-04	SS-026-05	SS-027-04	SS-327-04 Duplicate	SS-027-13
SVOCs (mg/kg)						
Benzo(a)anthracene	2,900	25.7	41.7	560	171	
Benzo(a)pyrene	290	40.3	70.9	438	147	2.12
Benzo(b)fluoranthene	2,900	95.3	108	517	150	
PCBs (mg/kg)						
Aroclor 1254	1,000					
Metals (mg/kg)						
Arsenic	2.7	2.5	3.88	3.14	3.0	4.11

Chemical of Potential Concern*	EPA Region 9 Industrial PRG	Landfill Trench TR-3		Landfill TR-4	Landfill Trench TR-5	
		SS-028-05	SS-028-11	SS-029-05	SS-033-01	SS-033-04
SVOCs (mg/kg)						
Benzo(a)anthracene	2,900	14.5		16.4		26.5
Benzo(a)pyrene	290	28.4		23.1		49.2
Benzo(b)fluoranthene	2,900	33.0		32.0		65.9
PCBs (mg/kg)						
Aroclor 1254	1,000	54.8	4.8 J	67.1 J	904 D	
Metals (mg/kg)						
Arsenic	2.7	8.02	2.32	3.57 J	1.1 J	0.983 J

*As identified by the human health risk evaluation for this investigation (Section 4.4)

Notes:

Bold value denotes that concentration exceeds PRG.

D - value is derived from a dilution

J - value is estimated

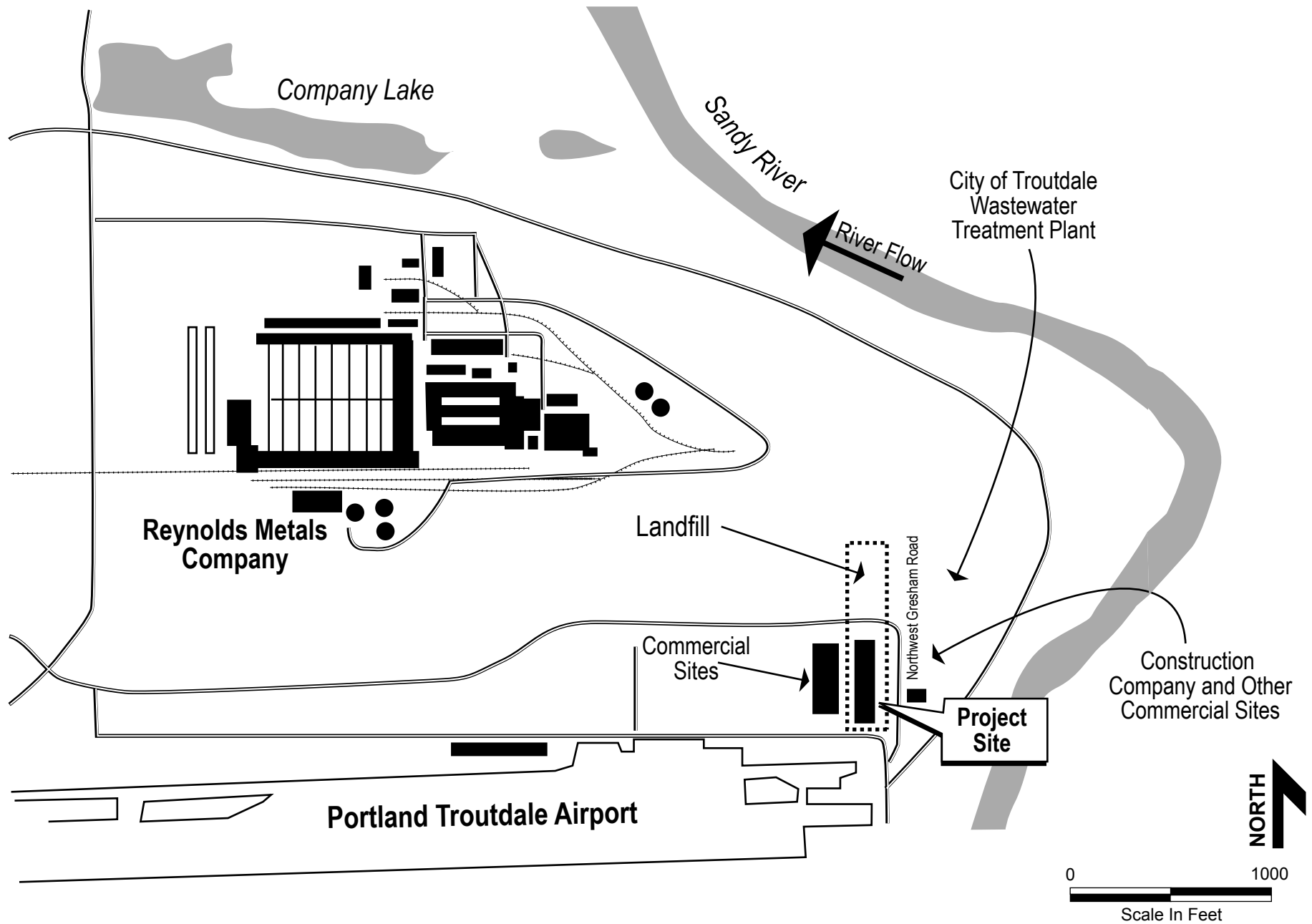
mg/kg - milligram per kilogram

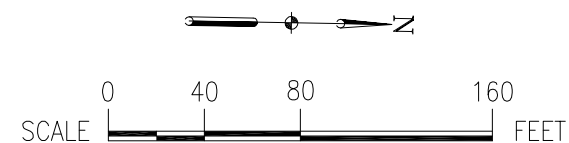
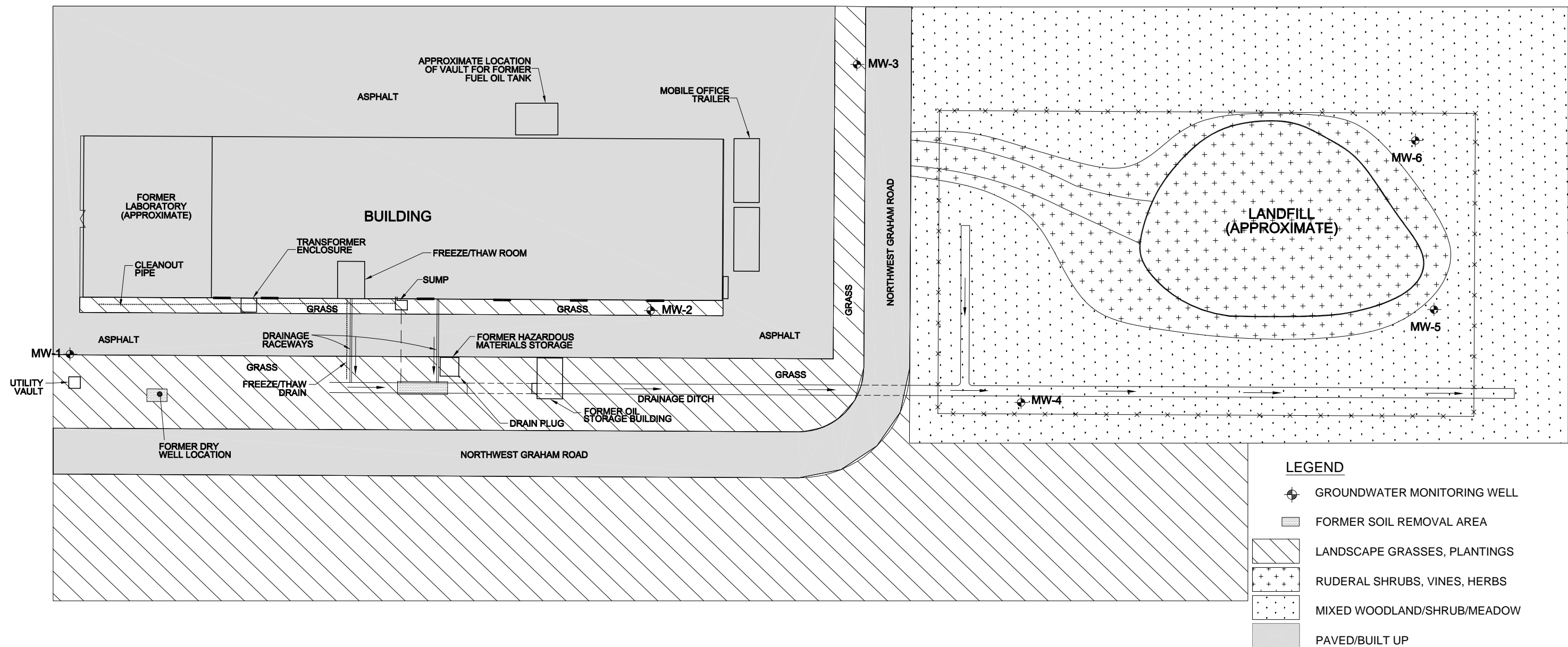
µg/kg - microgram per kilogram

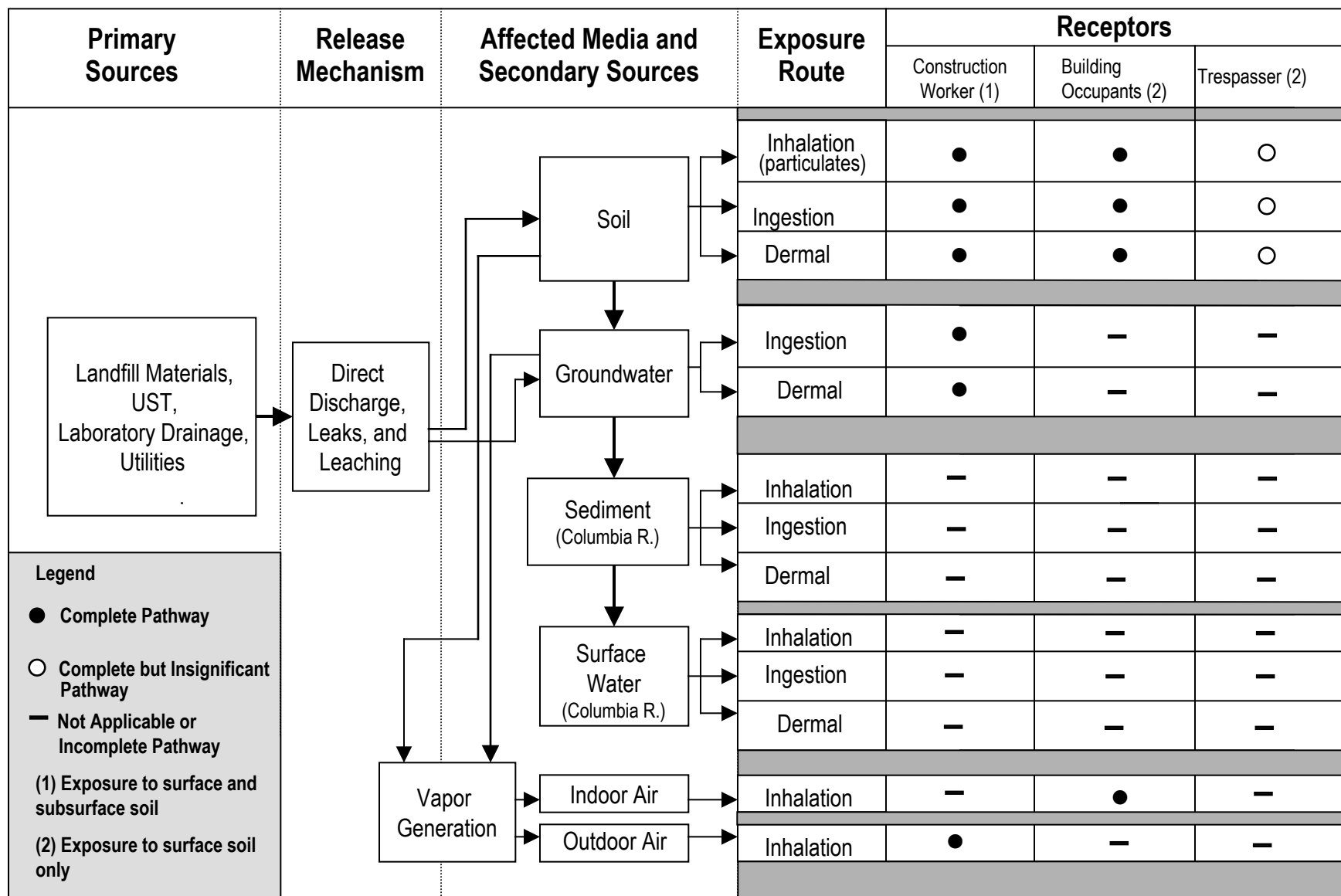
PCBs - polychlorinated biphenyls

PRG - Preliminary Remediation Goal

SVOCs - semivolatile organic compounds







5/1/03

Figure 4-3
Human Health Conceptual Site Model